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A
NEW SYSTEM
OF
NAVAL ARCHITECTURE.

**Patented successively by the United States of America ; The King of
Great Britain for England, Ireland, Scotland, and the Colonies ; and
by the King of France.**

A
NEW SYSTEM
OF
NAVAL ARCHITECTURE,

91

BY WILLIAM ANNESLEY.

LONDON:

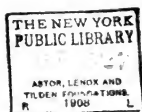
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TESTIMONIALS.

No. 1.

Extract from a Letter from THOMAS JEFFERSON, Esq. to THE AUTHOR.

Monticella, March 26, 1816.

As far as I see, your method is plausible, and especially promises strength of construction.

No. 2.

New York, November 27, 1816.

SIR,

I have examined your new mode for building vessels, and believe it to possess many advantages over the mode now practised, viz. safety, cheapness, and facility in construction.

And I do earnestly recommend it to ship owners as possessing the advantages of lasting longer, being more burthensome, drawing less water, and sailing faster ; and I have no doubt it will net a profit of 20 per cent. from the advantage it has over common vessels.

(Signed) NOAH BROWNE, Ship-builder.

No. 3.

Belfast, March 25, 1818.

Having been called upon by Mr. William Annesley to give our opinion respecting a schooner which he has built on a New System of Naval Architecture, and which he is the projector of, we have to state, that having

witnessed the various stages of building, we believe that a substantial vessel may be thus constructed considerably cheaper than in the ordinary manner ; that from her form and texture she cannot strain or make water ; that from 7 to 9 per cent. is gained in capacity ; and that in all probability she will last a considerable time without the usual repairs.

(Signed) WILLIAM RITCHIE and Co. Ship-builders.
RITCHIE and M'LAINÉ, Ship-builders.
JAMES CAUGHEY, Dock-master.
THOMAS GRIFFITH, Agent to Lloyd's.
MATTHEW HUNTER and Co. Ship-builders.

No. 4.

Extract from Captain M'DONNALL's Letter.

Bordeaux, October 13, 1818.

SIR,

After a tedious and cross passage, I am here at last. I encountered many hard gales, sufficient to try the little Annesley, but she overcame them all ; she is absolutely the best sea boat I ever set foot on.

(Signed), JAMES M'DONNALL

No. 5.

Extract from Captain GREENSLADE's Letter.

St. Lucar, February 22, 1820.

The Annesley proves a very fine little vessel, but too small for a possibility of leaving a profit in the present bad times.

(Signed) G. T. GREENSLADE.

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No. 6.

(Copy.)

M. DUPIN, *Engineer to the the Royal Marine of France, to the Author.*

London, October 21, 1819.

MY DEAR SIR,

In conformity with your wishes, I give you my opinion upon your manner of building ships. Your system appears to me in many respects very ingenious; you have taken every possible precaution to prevent your planks from becoming rotten by contact, in separating the various courses with tarred paper.

Your ship will evidently be more buoyant by far than those built according to the present system; the bottom will have a great deal of absolute strength and elasticity, to resist both pressure and percussion; and finally, all these advantages are rendered still more precious from the cheapness of your system.

I have only some doubt on the sufficient solidity in the connection of the bottom with the decks and the gripe; but experience will soon show whether these fears are unfounded or not.

I shall be very glad if they are so, and if the contrary, I am sure your ingenuity will find some means of remedying the future inconveniences presented by actual experiment.

Respecting your long and light boats, to be used in canals or rivers, they appear to me excellent, and of eminent advantage.

I am, Sir,

your most obedient Servant,

(Signed), CH. DUPIN.

P. S. As I set out to-day for France, I am sorry I shall not have the pleasure of seeing your ship launched. When you have any thing to acquaint me with you know how, by the way of the Consul General of France.

SIR,

I hasten to transmit to you the answer which I have just received from his Excellency the Minister of Marine, to the request which you desired me to address to him, which answer is as follows.

Paris, January 10, 1819.

" Mr. Annesley has stated to you his desire to obtain a copy of a report which Monsieur the Engineer Dupin has made to Mr. Secretary Mote upon his System of Naval Architecture.

" I regret that I cannot accede to this request; the reports which a Minister makes have only for their object to deliver his judgment, they are not designed to become public; if they were so, the persons charged with these reports would often be compelled to a circumspection and caution which might repress the free expression of their opinion. I pray you, therefore, to inform Mr. Annesley of this refusal as agreeably as possible, and at the same time assure him, that Mr. Dupin has rendered entire justice to his experience and his knowledge, in the art of Naval Architecture."

I regret much myself, Sir, at not being able to fulfil your instructions, and I pray you to accept the assurances of the sentiments of distinguished consideration with which

I have honour to be,

Sir,

Your very humble and obedient Servant.

No. 7.

Extracts from Captain JOHNSON'S Letters, of the Brig Annesley.

St. Christopher's, October 15, 1820.

Our passage at first was very tedious, in consequence of continued calms all the way through the Channel; we were only 100 miles to the

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westward of Ushant the 18th of September ; the remainder of our passage has been fine, and I am happy to say, that we arrived here in as good order as the day we left England. The brig Thetis, of London, sailed the week previous, and we came up with her in latitude $17^{\circ} 20'$, and longitude $55^{\circ} 18'$, about 340 miles from Deseada ; we continued in sight of each other for nearly two days, when we ran her out of sight ; I have been able to get ten knots out of the Annesley at sundry times, which is the most, except it may have been in a squall before we could take in canvas.

No. 8.

St. Kitt's, November 8, 1820.

We are now nearly out, except the bricks, tiles, and lime ; I am happy to say that every thing has been delivered in good order ; just after I wrote to you last, we had a severe gale of wind direct in the bay, by which we had the misfortune to lose the jolly boat, which went on shore amongst the rocks and could not be saved ; we rode the gale out very well, although we upset our windlass and carried away the main pall.

No. 9.

December 21, 1820.

I find that they have positively refused insuring any sugar shipped on board the Annesley, which must proceed from prejudice, as I can prove that the cargo out was as heavy within a few tons, as a cargo of sugar and rums ; however, the prejudice here is equally as much as in London.

No. 10.

(Copy.)

We, the undersigned Consignees of the cargo of the snow Annesley, whereof James Johnson is master, now riding at anchor in the Roads of Basseterre,

Do hereby certify, that we received that part of a cargo consigned

TESTIMONIALS.

to each of us in good order and well conditioned, and in every respect perfectly to our satisfaction; in witness whereof, we have voluntarily signed our names, the 19th day of December, 1820.

(Signed)

ROBERT DREW and Co.
PAULL and BURT.
JAMES BERRIDGE.
MARY ANN THURSTON.
MARY MARR.
SUSANNAH GRIMES.
G. M. PICKERING.
W. D. SHARREY.
JAMES AKERS.
JAMES QUELCH.
FAVEY and FORSTER.

INTRODUCTION.

WILLIAM ANNESLEY'S System of Naval Architecture consists in building, from a justly proportioned model, vessels of every description, and dimensions, with planks or boards as the tonnage requires) which are laid in courses at right angles alternately, longitudinal, vertical, or oblique, where the curve requires it, upon moulds formed from sections of the model. These moulds are not (unaptly) compared with centres of arches in civil architecture, and may be removed when the last athwart course is laid on.

The first course is caulked and payed after the moulds are removed; each succeeding one may be caulked, payed, and papered, as laid on, until the last, which is finished as usual.

As the thickness of the plank is proportioned to the curve they have to bend to, no firing or steaming is required, and the full strength of the fibre is preserved. Excepting boats, and peculiarly formed vessels (such as the first Ocean Steam Boat), where planking is too thin to admit of it, I used compressed trenails for fastening; and thus producing, by wood alone, a combination in form and texture of the utmost solidity, strength, buoyancy, and capacity, united with an elegant form, and capability of the swiftest sailing or propelling.

This principle excludes frame timbers, beams, knees, breast hocks and stem, and the necessity of metal below water, with the above exception.

The manner of building the brig *Annesley*, of 256 tons, Plate I. and II. ; the vessel at Nine Elms, above 100 tons, the first continued entirely round ; bottom, sides, and deck presenting one entire uniform body, Plate II. and III. ; and the first Ocean Steam Packet, built at Deptford, launched 10th March 1822, Plates IV. A, and IV. B, are described in the *Origin and Progress of the System*.

To form the model. Take two pieces of American yellow pine or other soft wood, that, placed together, are equal to the size of the vessel intended in a scale of $\frac{1}{4}$ or $\frac{1}{2}$ inch to the foot ; joint and key those pieces together so that they may be modelled as one, and use the utmost care and attention in the formation, as it will be the exact miniature of the vessel when finished.

The elliptic form displayed in the annexed plates is recommended by the Author as the best adapted to every species of service, as the difference required for stowage or sailing, only consists in the vessel being made more or less full fore and aft.

The dead wood, cut-water, and keel are formed slightly attached to the model, merely to give it a finished appearance, and the builder a just conception of its proportion.

The model is now separated, and the one half of the semi divided into equal parts ; the distance and number according to the length of the vessel, as Plate I. fig. 1.

The angular moulds are formed by a straight slip of stiff paper bent round the bow of the same model, as from A to B, fig. 1, Plate I. drawing the line by the slip, and fitting thin pieces of hard wood in the direction the moulds will stand, and laying those curved pieces on the section paper.

To cut the vertical sections, place the semi-model in a trough or cutting box made to fit it exactly, having a perpendicular cut in the centre and square athwart ; by moving the model along the box till the divisions come in the line of the cut, and running the semi-model through with a fine sharp saw, the sections will be

all perfectly perpendicular and square from the base line of the bottom.

The sections being cut, are smoothed at the edges with a file and sand paper, that the pen may run freely round them when laid on the section paper, such as fig. 1. Plate II. As the brig was built and the first plate engraved before I extended the principle all round, the method in forming the moulds for an open vessel may be sufficiently understood by inspecting Plate I. fig. 2.

Plate II. fig. 1, is drawn from the section of the model on which the vessel at Nine Elms was built.

It is the earnest desire of the Author to arrest the attention and solicit the investigation of men of science, respecting the total change and great improvements in naval architecture, contemplated in his system, from the London Wherry to the Steam Battery of 10,000 tons.

Public benefit demands the deliberate judgment of every friend of humanity, upon a subject so deeply involving the interests of life and property.

In no instance will his invention be found to abridge manual labour, but the workman is relieved from severe exertion in distorted attitudes, and the builder's mind from perplexity.

He has given the results of repeated experiments made in the presence of scientific men, to show the benefit of side keels, and the necessity of an uniform figure for easy entrance and delivery, upon a keel parallel to the horizon, as the most favorable for safety and sailing; and to make it evident, that Ocean Steam Vessels may be so constructed on his system, as to perform well in the severest gale of wind and heaviest sea, and that steam batteries may be built for coast or harbour defence, to an unlimited extent of tonnage and of tremendous power, utterly unattainable by the present method.

The inventor has made out estimates in detail, of vessels from

50 to 2000 tons, on the same scale of proportion, and finds, that excepting the addition of inner decks to the larger vessels, that the price of building, per ton, is very nearly the same in all.

And he trusts to make it sufficiently clear, that vessels of the largest class may be built of strength perfectly proportionate to those of the smallest size. Therefore, as all vessels are agitated in the same sea in proportion to their bulk, the largest will suffer least in extremity of danger at sea or on shore. The very reverse of this is the consequence of building with detached timbers.

ORIGIN AND PROGRESS OF THE SYSTEM.

As the principle of building is the same in all, yet having extended it entirely round, altered the general form, and introduced new methods of setting up, building, and fastening; invented tools and instruments to facilitate the work, and render it more correct, all which the author used in the latest built vessels, he thinks it unnecessary to detail the particulars of those previously constructed.

Year 1813. In Albany, state of New York, U.S. he built the *Nonsuch*, 33 feet long, 11 feet wide, and 4 feet 6 inches deep, in 3 courses; 1st, fore-and-aft of white pine $\frac{7}{8}$ inch thick. 2d course athwart, $\frac{1}{2}$ inch of white wood (lime tree). 3d. Same as first, with two courses of paper. She was full forward, lean and much cut up aft, according with my judgment at that time. She sailed and wrought remarkably well, registered nearly 10 tons; cutter rigged.

In the year 1815, he built the *Nautilus*, a half-decked boat, 21 feet long, 7 feet wide, rigged with two shoulder-of-mutton sails and a jib. She outsailed a number of sloops and packets some miles in a tide, in a passage from New York to Albany, with the wind right ahead, and so fresh as obliged the sloops to single reef.

In October 1817, the inventor built at his native place, Belfast, in the north of Ireland, the schooner *Annesley*. Her extreme length is 49 feet, width 15 feet 8 inches, depth of hold 8 feet, consisting of 5 courses of Quebec oak, three fore-and-aft of $\frac{7}{8}$ of an inch thick, and two transverse $\frac{1}{2}$ inches, intire thickness $3\frac{3}{4}$ inches. The longitudinal courses are caulked, payed, and papered. This is the

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last vessel I have built with square stern, full forward, and lean aft. She is considered by all who know her as the strongest and smartest vessel of her size sailing out of the port of London, where she has lately been employed, chiefly in the Mediterranean and St. Michael's fruit trade.

In 1818, Messrs. J. and T. Brindley, of Frinsbury, Rochester, built the sailing barge, *Safety*, Plate X. fig. 2, of the following dimensions, 65 feet length, 15 feet breadth, and 5 feet 4 inches in depth of hold, consisting of 5 courses, 3 fore-and-aft of 14 Baltic fir, and 2 athwart of $\frac{3}{8}$ inch, same quality; total 5 inches through.

This barge has two side keels, 30 feet long and 9 inches deep, so that when light, though drawing only 15 inches water, she carried sail stiffly, and held a good wind. She sails with 35,000 bricks from Frinsbury to London, when the ordinary load for vessels of rather larger dimensions is only 22,000, and outsails most others with her vastly additional burthen, and would carry much more in point of masts and sails (as Mr. T. Brindley informed the Author,) than she now does. She has been running ever since, employed in their severest service, remains perfectly tight, and has not required the slightest repair.

The weight of a brick being about 5lbs. her additional power of burthening is nearly 30 tons, compared with that of vessels built upon the old method.

In 1819, the Inventor built the barque *Annesley*, at Deptford; extreme length 91 feet, width 25 feet 2 inches, depth 13 feet, burthen, by register, 256 tons.

The manner of building this vessel is given here, as being the largest, having sailed the greatest distance, and at that period, built the most consistent with the Author's knowledge of form, proportion, and fastenings.

The extension of the principle entirely round, he displayed in a

model of an Ocean Steam Boat at the above period, and in forming the raised cabins of the canal boats then built at Deptford.

The model, Plate I. fig. 1, was formed on a scale of $\frac{1}{2}$ an inch to a foot. The drawing is 1 inch to 32 feet.

Fig. 2. Centre section of model, with the manner of striking out the moulds, on a scale of 16 feet to an inch.

Fig. 3. Centre mould.

Fig. 4. Perspective view of moulds set up.

A. A. Fig. 4. Fore-and-aft mould formed for convenience in two lengths : on this was laid the first fore-and-aft centre plank, with wood screws.

B. B. The vertical moulds set up at right angles to the base of the fore-and-aft mould ; they rested on, and were clamped to, the centre plank.

C. C. Fore-and-aft trimmers.

D. D. Sheer mould of 2 inch plank carried all round, and temporarily fastened to the fore-and-aft trimmers, and secured to the moulds with clamps and screws, to bear the strain of the transverse planking.

The first fore-and-aft course shown in Plate I. fig. 6, A, consisted of Baltic fir planks of $\frac{7}{8}$ inch thick ; they were attached to the moulds by iron clamps, see fig. 5. Plate I. ; the point of the clamp A was driven into the mould, distant from the edge the length of the bend, so that the turn B was fair with the edge of the mould, having a hole to admit a $\frac{1}{2}$ wood screw into the plank ; these clamps were made of flat iron, an inch wide and $\frac{1}{8}$ of an inch thick ; the point A $2\frac{1}{2}$ long, the bend 2 inches. They were made for 12s. per hundred, and answered perfectly well.

The fore-and-aft mould was now removed to allow the cross planking to pass round, by turning out the wood screws that attached it to the first centre plank.

The second course, fig. 6. B, $\frac{3}{4}$ of an inch thick, was laid from

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gunwale to gunwale, at right angles to the first. This course was united to the first by trenails of Memel timber $2\frac{1}{2}$ inches long, having been strongly compressed to drive through a hole made by a gimblet bitt and brace of $\frac{1}{4}$ of an inch in diameter.

The third course (second longitudinal), 1 inch thick, was firmly united to the preceding by trenails 3 inches long and $\frac{3}{8}$ in diameter; the iron clamps that held the first course to the moulds being previously removed to prevent injury to the boring bits. This course was well caulked, and payed with hot well boiled pitch and tar, upon which plain paper was instantly laid, the air well pressed out, and afterwards payed on the outside.

The fourth course (second transverse,) $\frac{1}{2}$ of an inch thick, was fastened with $\frac{1}{4}$ inch trenails $2\frac{1}{2}$ inches long, and bored with a stop bitt to prevent it penetrating farther than the length of the trenail. This course was caulked, payed, and papered.

The fifth course (third longitudinal,) was $\frac{7}{8}$ of an inch thick, laid with $\frac{3}{8}$ trenails 3 inches long, bored with stop bits; was caulked, payed, and papered.

The sixth course of $\frac{1}{2}$ was fastened with $\frac{1}{4}$ inch trenails $2\frac{1}{2}$ inches long, caulked, payed, and papered.

The seventh or last course (fourth longitudinal,) of 1 inch thick, planed.

A correct centre line was first struck fore-and-aft for the dead wood and keel, Plate I. fig. 7, A. A, to hold which two red pine planks, were selected of $1\frac{1}{2}$ inch thickness; a rabbet, 4 inches wide and half an inch deep, was made in the inner side of each, and their edges were united at the centre line, thus forming a groove 8 inches wide and $\frac{1}{2}$ an inch deep, adapted to receive the upright dead wood. These two planks were fixed with compressed trenails 8 inches long and $\frac{1}{2}$ an inch in diameter. The centre joint was then well caulked and payed.

The seventh course, with the exception of the two centre planks,

was united with the preceding courses by trenails of $4\frac{1}{2}$ inches long, compressed for holes of $\frac{3}{4}$ in diameter.

In the former courses no more trenails were driven than were considered necessary to keep the planks in their places when building; but, in this last course, each side of the planks which averaged 8 inches breadth, was trenailed at regular distances of 7 or 8 inches; a trenail being driven into one side of the plank opposite the space between two trenails in the other; they were secured at the head by square diminishing oak pins (or props) driven into a hole made by a punch formed for the purpose. When the last course was laid and squared off, the moulds were entirely removed, and the inside course trenailed to the body (where required) with $3\frac{1}{2}$ inches long, and $\frac{3}{4}$ diameter. The inside and out being cleaned off, were well caulked and payed.

Where the wales are usually placed in ordinary vessels, 4 strakes were laid on, each $6\frac{1}{2}$ inches wide and 1 inch thick, of Quebec oak, forming (what I term) a belt, passing entirely round the ellipsis, 1 foot below the gunwale, thus embracing, stiffening, and strengthening the whole structure.

The core, or upright dead wood, was meanwhile set up, consisting of fir timber, sawed to 8 inches thickness, and entering $\frac{1}{4}$ an inch into the groove formed by the rabbets, which rose fore-and-aft to the base and stern, as seen in Plate I. fig. 7, at A. A.

The dead wood was put together with square keys 10 inches long by 5 inches wide and 2 inches thick, fixed into corresponding mortices in each piece; the whole resting on an elm plank of $2\frac{1}{2}$ thickness, and 8 inches wide, dovetailed into the cut-water and stern-post.

The upright pieces forming the core of the dead wood, were well secured from the inside with oak trenails of $1\frac{1}{4}$ inch diameter, and 12 inches long. A longitudinal course of planking $1\frac{1}{2}$ inch thick, as at B. B. fig. 7, Plate I. was laid on each side the upright

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dead wood, and fastened with trenails $4\frac{1}{2}$ inches long and $\frac{3}{4}$ in diameter. Another elm plank, termed the sole, 11 inches wide and $2\frac{1}{2}$ inches thick, is carried fore-and-aft, projecting a few inches beyond the stern-post to protect the rudder, and inserted forward in the cut-water. Plate III. fig. 3, shews the rabbet made in the stern post to receive the fore-and-aft planking of the dead wood.

The cut-water was of oak, with a rabbet similar to the stern-post, to render all flush.

The stern post of this vessel was placed outside and upright, fitted to the curve of the stern, and hung on a cylindrical joint, but with concealed hooks and pintles; therefore, as I conceive a better method will be displayed in the progress of the work, I think it unnecessary to dwell on this.

The fillets to secure the dead wood, Plate II. fig. 1, S. consisted of 3 courses of $1\frac{1}{2}$ red pine plank, the first course 10 inches wide in the flat of her bottom, and diminishing as it rose fore-and-aft to the belt under which it terminated; the second course 8 inches, the last 6 inches; these courses were well trenailed, the last with $\frac{3}{4}$ in diameter, compressed.

The bilge (or side) keels, Plate I. fig. 7, C. each 45 feet long, 14 inches deep, and 6 inches thick, were fixed 12 feet apart, each 6 feet from the centre of the vessel, perfectly parallel to it, and equidistant from bow and stern, the under edges were level with the centre plank of bottom. The sides were regularly curved from the middle, diminishing to the thickness of 4 inches at the ends, the extremities raked as in the drawing. They were cross-planked on the inside with 1 inch fir, bored with a $\frac{3}{8}$ inch bitt, and fastened to the bottom with inch oak trenails driven from the inside at 16 inches apart; on the outside they were secured by fillets of 2 inch plank.

The deck clamp consisted of 4 courses of 1 inch fir plank 9

inches wide, bent round the ellipsis 12 inches below the gunwale at the waist, 25 at the stern, and 29 inches at the bow, to give room for hause pieces, night-heads, belaying timbers, &c. Into this clamp were inserted the ends of the first course of the cross planks that determined the fore-and-aft dimensions of the several openings, Plate III. fig. 1, B. B. B. B. These planks were 11 inches broad and $1\frac{1}{4}$ inch thick; a second course was laid over them, and the spaces between the planks at the clamps were filled up with $1\frac{1}{2}$ inch stuff, which rendered all fair for the first course of fore-and-aft planking for the deck. Two planks of $1\frac{1}{2}$ inch were placed at the openings rather than one of 3 inches for actual strength, and for bending more regularly to the curve of the deck-mould.

The first course of fore-and-aft deck planking, Plate III. fig. 1, C. $1\frac{1}{4}$ inch thick were fastened to the double cross planking with trenails 4 inches long, compressed for a $\frac{3}{8}$ inch hole; it was payed, tarred, paper laid on, and the joint between the gunwale and the deck was well caulked all round.

The second deck course D was laid on athwart of $1\frac{1}{2}$ inch plank, secured with 4 inch trenails of $\frac{3}{8}$ diameter.

On this course the comeings of the hatchways were laid; they were rabbetted on 2 inches, and allowed to go down as far as the lowest part of the cross planking. This course was caulked, payed, and had paper laid on.

The last deck-course was laid fore-and-aft of $1\frac{1}{4}$ red pine plank except the 2 outside planks of 2 inches thick, to allow being holloed for the waterway. This course was fastened down with trenails 6 inches long, compressed through a $\frac{1}{4}$ inch hole, and propped with oak pins in the centre between the deck and the gunwale all round the ellipses, and the deck joints were firmly caulked and payed without extending the sides in the least.

Above the deck up to the gunwale was laid two courses of spir-

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ketting of 1 inch stuff all round, which formed, with the clamp below, a firm groove for the deck ; the spirketting rose flush with the gunwale, and was planed fair with it, and hot well boiled pitch and tar were poured on and well wrought in with a mop to fill up the ends of the cross planking and run into the joints ; on this were laid tarred paper, and the covering plank in two courses all round of $1\frac{1}{2}$ inch thick, the upper course of oak, projecting one inch on each side ; this was fastened with $\frac{3}{4}$ trenails 6 inches long.

The staunchions were of oak, 7 inches athwart at the gunwale, and diminished to 4 inches at top and 5 inches fore-and-aft ; they were let into the covering plank 2 inches, and the foot into the waterway plank $1\frac{1}{2}$ inch, with a bolt through the gunwale just below the covering plank ; they rise 2 feet 4 inches high.

The rail was made in two courses of red pine, lower part 5 inches wide, $2\frac{1}{2}$ inches thick, morticed to receive tenons cut in the staunchions ; the cap 6 inches wide, flush inside, and projecting one inch to receive the bulwarks, put together with oak $\frac{3}{4}$ trenails ; the cap was ploughed with a $\frac{1}{2}$ inch bitt to receive the upright course of the bulwarks.

The bulwarks were made of $\frac{1}{2}$ inch deal, and in two courses ; the upright was planed and beaded inside, and cut by a standing length to enter the groove of the rail and fit down to the covering plank, on which a slip was tacked to keep its range. The fore-and-aft course was slit into breadths of 4 inches, to be easily bent to the sheer of the vessel ; the courses were nailed together.

The knee of the head, Plate II. fig. 4, was formed by a mould, which was fitted to the cut-water and laid down on a floor, when the upright pieces B were fitted to the draft. These upright pieces were put together with keys, to correspond with mortices, in each piece. The cut-water was reduced the thickness of the fore-and-aft planking 1 inch on each side, to render it all flush when

finished, as at C. A piece of inch elm was bent round to the scroll D, to cover the ends of the courses; rails and cheeks, as usual, were affixed.

A vessel was built in 1820, under the direction of the Inventor, at Nine Elms, Vauxhall; extreme length 82 feet, 17 feet greatest breadth, 9 feet depth of hold. See Plate II. fig. 2 and 3; and Plate III. fig. 2 and 5.

It was not thought necessary to make a distinct drawing of the moulds set up, because those of the barque *Annesley*, Plate I. fig. 4, are sufficient to display the method; the only difference consisted in continuing the curve all round the vessel, the deck forming part of the ellipsis, as shewn by a half middle section of the size of the model from which she was built, on a scale of $\frac{1}{2}$ inch to the foot, Plate II. fig. 1.

The method of striking out the moulds is exhibited in the same figure, a perpendicular line being drawn across the paper for the centre; the flat of the section is laid accurately to it, and the line A. A. A. drawn by a pen round it. The semicircle B. B. B. is described from the centre C, and divided into a number of equal parts (here 15), and lines drawn accurately through each point to where they strike the outside of the section A. A. A.

These lines are measured from the centre to the section line by the $\frac{1}{2}$ inch scale, and marked as per figure, and then transferred to the moulding loft or platform.

The small semicircle round the centre C is only to prevent the confusion of lines.

The parallel lines F. F. from the points may be drawn to detect any errors.

The first course fore-and-aft is shewn in Plate III. fig. 2, A.

The second, and first of transverse, B. The direction of the transverse planking at bow and stern is shewn at C. a foot beyond

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which the fore-and-aft shelf pieces extend, the ends of which are shewn in the section fig. 3, at C. C.

This vessel, designed for a singular purpose, was built uniformly strong all round in seven courses, four longitudinal of 1 inch thickness, and three transverse of $\frac{1}{2}$ inch, all of Quebec oak, being two courses more than sufficient for any vessel of her size.

This vessel was fastened with oak compressed trenails, having five courses, caulked, payed, and papered, as before described.

The sides of the decks were raised upon brackets, the ends of which are shewn in Plate III. fig. 5. The staunchions let into the ends of the brackets and fitted to the curve of the side as L. M. Plate II. fig. 1. The deck thus presented the flattened curve T.; but the Inventor recommends, as it may be done at much less expense, (especially in merchantmen, full built), that a platform or gangway, between 3 and 5 feet wide, be laid level, to give good footing; this would leave a very small vacancy between for the brackets, and least of all so when the staunchions and bulwarks are made as shewn in Plate V. fig. 1; a form serviceable in a heavy lurch, throwing off the spray of a sea, and handsome in appearance.

The Steam Packet, Aire, built at Selby, Yorkshire, by Robert Myers, Esq. commenced running July 1821, between Hull and Selby. Dimensions: Length 79 feet; breadth of hull 18 feet; outside of paddle deck 31 feet 6 inches; diameter of paddle wheel 11 feet; 11 paddles; breadth of ditto 5 feet 6 inches, dip of ditto, in general, 1 foot 4 inches, varying according to the goods on board; with a 30 horse engine, giving 30 strokes per minute on the first motion; register tonnage 125 tons: draught of water with all on board, 3 feet 9 inches; consisting of five courses of American pine, first, fore-and-aft, $1\frac{1}{2}$ inch thick; second, athwart, 1 inch; third, fore-and-aft, 1 inch; fourth, athwart, 1 inch; fifth, fore-and-aft, $1\frac{1}{2}$ inch;—being 6 inches through. Each course caulked, with tarred paper between.

Extract of a Letter from Robert Myers, Esq. to the Author, dated Selby, May 22, 1822 ; containing the above information.

" The Aire Steam Boat is now plying between this place and Hull, a distance of 55 miles, which she, in spring-tides, performs in three hours and a few minutes, with a tide never running more than from six to seven miles an hour, and stops her paddles at seven ferrys until the boats get alongside. As a convincing proof of her strength, after her running for some months, it was found necessary that a feed-pipe should be put through her bottom, which we could not accomplish, being overwide to get into dock. We therefore laid her across a rivulet, with only both ends hold about six feet (so that people walked under her), without even the least straining, although the whole of her machinery, water, &c. was directly in the middle of her, which weighed upwards of forty tons ; and lay in that situation for two days without any support under her for at least fifty feet, which was the astonishment of all our ship owners here. She is uncommonly tight, so much so, we have a cock through the bottom to let water in.

" P. S. The Aire this morning came from Hull in three hours and twenty minutes."

Note. In a former letter from this Gentleman, he writes, the Aire performed the same distance in three hours and five minutes, by which the Author understands the *few*, mentioned in the above extract. It is well known that vessels floating in a current that runs seven miles an hour will not advance more than six.

Description of the Hope, Ocean Steam Packet, built at Deptford by the Author, launched March 10, 1822.

Greatest length, from the fore part of the breast trimmer to the aftermost part of the stern trimmer, 56 feet 4 inches ; greatest breadth, midship, outside of belt (wales), 15 feet 1 inch ; depth of

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hold each side of mid channel, 6 feet 10 inches ; height of mid channel from lower part of bottom saving plank outside, 2 feet $8\frac{1}{2}$ inches ; width of mid channel and upright wheel course, 3 feet ; width of paddles 2 feet 9 inches, depth 9 inches, with sliding arms to dip from 12 to 18 inches ; diameter of water wheel 10 feet, with eight paddles, moved by an engine of 10 horses power.

This vessel is built of Quebec oak, fastened with copper nails, consisting of four courses ; first, fore-and-aft, of $\frac{1}{2}$ inch stuff ; second and third, $\frac{1}{4}$ inch, each athwart in succession, bending into her circular channel, and passing entirely round her barrel (or body) ; between these is laid on a course of adhesive papering, with stiff flour and allum paste, and when dry, brushed over with linseed oil ; the third course is chinned with white oakum and payed ; a coat of well boiled tar and lime was then laid on hot, so hard as to bear a firm touch without impression when cold, when plain paper was laid on, and with heated flat irons made firmly to adhere to the work ; over this was laid a coat of the former stuff, and the last course of $\frac{3}{4}$ inch, laid, caulked, and payed up to the sheer strake. The brackets and staunchions were then laid, as shewn at large, fig. 1. Plate II. at L. and M. of 2 inch oak, the staunchions at 3 feet apart, with a bracket between, on which the deck was laid of $1\frac{1}{4}$ inch red pine. The belt of 4 strakes of 5 inches wide was then laid entirely round, and the knee of the head built, as shewn in Plate II. fig. 4. In the centre of each bottom, fore-and-aft, is laid a saving bottom plank 36 feet long, 9 inches wide and $1\frac{1}{2}$ inch thick, trimmed off at the ends, and 2 inside planks of the same dimensions, as keelsons ; these are secured together with $\frac{3}{4}$ inch trenails, passing through the keelsons bottom, and saving planks outside.

In the engine-room is laid a floor of $2\frac{1}{2}$ inch oak plank, fitted to her bottom, on which the timbers necessary to secure the cylinders are placed, and bolted through her bottom.

Previous to launching this packet, a singular proof of her strength occurred. The vessel was shoared up from the floor 3 feet 1 inch high under her belt (wales), in the usual manner by the shipwrights, in order to caulk her bottom and remove (what may be termed) the stilts she was built on; the last plank of which was hauling out when the vessel took a sway aft of 6 feet, struck her stern a little below the belt against her boiler, removed that some distance, which forced out a wharf plank, leaving her resting aft on the edge of the boiler, and her fore part on the ground. In this situation she preserved a fair line of bottom, and was raised immediately with jack screws, without receiving the slightest injury; the direct fall of the fore part was 3 feet 1 inch; where she struck the boiler the grain of the wood was not broken nor a nail started.

This unexpected and extraordinary proof of strength the Author would not from choice have submitted her to; yet by an inferior calculation of the strength of her fibres, she would bear upwards of one hundred tons pressure, applied vertically and horizontally, the force embracing 6 feet each way, without complaint, which, it is believed, will be considered sufficient to the working of a ten horse engine.

The Author had prepared an engraving and description of the best wooden rudder he then could conceive; but from the small expense, the durability, security, and effect produced by the iron rudder and case, adopted in this vessel (and which is equally adapted to all descriptions of boats and ships), he has good reason to believe metal rudders and cases will supersede the use of all others.

This vessel was launched on two pieces of cut timber planed, with ribands nailed on, as guides to the bottom saving plank to run in, allowing $\frac{1}{4}$ of an inch free of the sides and depth of the slips; being built on a level (from want of room), she was readily lowered aft to the declivity of $\frac{1}{4}$ inch to the foot with jack screws.

D

The reason of using metal fastenings in this vessel is on account of the slight substance of the courses, as compressed trenails would always be preferable where the stuff is $\frac{3}{4}$ of an inch, to be attached to $\frac{1}{4}$ and upwards.

In building another vessel, so light in the courses that nailing becomes preferable, the Author would use iron nails, not alone on account of the expense of copper, but partly that they will not hold, should there be any omission in holding on firmly, and soundly clenching, on which they depend. As the nailing of the inside courses may be securely preserved from wet, and being driven into well seasoned stuff, the iron will endure a long period ; and the outside being kept well painted and payed, iron nails will last from ten to fifteen years, in those vessels and boats that entirely depend on their holding, and are continually on the strain. It may therefore be expected, that in vessels of this system, iron nails will serve a much longer period, and then at a trifling expense be nailed off where required.

By a calculation of the Author, previous to her launching, the Hope was to weigh 11 tons, and to draw 12 inches water, measuring 56 tons, including the channel ; when launched with 4 tons of iron on board, she drew on a medium fore-and-aft 16 inches water. With engine, boiler, fuel, and fifty persons on board, she draws 2 feet 4 inches.

As this vessel is the first ocean steam boat built on the new system, and in which the Author has endeavoured to combine all the advantages, he has yet been able to discover, in this form and method of construction, he considers it important, to render it easily understood by the drawings and references annexed to the work, according to his best abilities on the subject.

Without adverting to the security of the steam vessels at present, with outside wheels and weighty top projections, it must be confessed, that from the extensive bearing of the two bottoms, and the

body of water in the mid-channel, this vessel must possess in the greatest degree stability ; and to the resistance to lee way, afforded by the trunk, may be added, if requisite, side (or bilge) keels, that will enable her to hold a wind equal to the sharpest built vessel. That having her water wheel precisely in the centre each way, it is subject to the least possible motion by pitching or rolling ; that in the heaviest sea outside, the wheel dips equally, as in moderate weather, being governed by the forward part of the trunk, which gauges the quantity, like the water laid on a mill wheel. It is therefore certain, this vessel can work her engine in all weathers ; and must proceed, until the wind and sea are so violent, as to exceed the power of the engine, which can scarcely be conceived ever to happen in these latitudes.

That a steam engine may be wrought with as much safety at sea as on shore, and that no more apprehension will be shewn, on taking a voyage across the Atlantic in a steam vessel, than in taking lodgings ashore in the vicinity of a steam engine ; and that steam packets will become heralds round the globe, on the principles of security, economy, and dispatch, in preference to all others, is most probable.

To vindicate the principle of this ocean steam boat, from the unjust imputation of failure that may be imputed to her construction, by interested prejudice and echoed by ignorance, the Author states the following facts.

An old double engine of nominally 10 horses power, formerly employed in the Hope of Richmond, was put on board this vessel, and fitted up to work as one.

There have been several ordinary workmen in succession, employed in fitting it up, and they have never succeeded in working the engine to above a 3 horse power, nor even that but for a very few minutes ; being on the first motion, she always hung on her centre, and of many trials, only once, by means of an engineer, did

she work herself for a very short period, not exceeding 15 strokes a minute; when she stemmed tide at half flood from Deptford to Blackwall, at the rate of $2\frac{1}{4}$ miles per hour, making $5\frac{1}{4}$ miles through the water. From this and other similar trials, it is allowed by some of the best informed, that give her two engines to work fully equal to 10 horses power, she would be at least equal in speed to any on the river in still water, but in a sea, she must progress with safety, when no vessel with outside wheels could make way.

To support the above opinion, the Captain of a steam boat, then lying in the Surrey Canal (18th May), designed to run from Dover to Boulogne, informed the Author that the burthen of his vessel was 54 tons, register the entire hull, for which he was then taking engines of 12 horses power each.

Mr. Evans, builder, was about launching one at the same time of 50 tons, for which he had prepared two engines of 8 horses power each. All these engines were complete, from the first engineers of reputation.

In May, this year, was launched a schooner barge at Frinsbury, by Messrs. J. and T. Brindley, 80 feet extreme length, 14 feet in width, and 7 feet depth of hold (designed to bring coals from the north and enter the canals), built of fir, in five courses.

A brig 96 feet extreme length, 24 feet breadth, and 13 feet depth of hold, is expected to be launched in a fortnight, at the same place, built of fir, consisting of five courses, making 6 inches through, or $\frac{1}{4}$ inch to the foot of width.

MEASUREMENT.

FROM the uniformity of the figure, and equality of thickness throughout these vessels, their actual weight and capacity may be readily calculated, with an accuracy unattainable, in vessels built with detached timbers and of complicated form.

SIMPLICITY AND ECONOMY IN BUILDING.

By this system of construction, from twenty to forty per cent. may be saved.

A vessel built on the old plan, requiring $3\frac{1}{2}$ inches merely for her outer and inner planking, is encumbered besides with the weight, and loaded with the expense of heavy timbers and metal through every part of her hull; whereas a vessel on this system, witness the schooner *Annesley*, built with five courses, altogether making but $3\frac{1}{8}$ inches in thickness, requires neither timbers nor metal; in fact, timbers and metal would weaken her.

A stout vessel of the schooner's size may be built of three courses only, by steaming the plank, and in all making only three inches through, by extending the principle all round, as will be justified by the *Hope* ocean steam packet.

Overhauling and caulking, so frequently required in other vessels, will not be requisite for a great length of time, in these, which do not open their seams, having no space to strain to, as those built with detached timbers; the oakum being firmly set in, the seams retain it.

Upon this system, should a vessel be built remarkably light for some particular purpose, she may be strengthened at any future period, according to the service required, by an additional inner course, with little more expense than would have been incurred in the course of her first building, which is impossible, consistent with prudence, on the old method.

BUOYANCY.

It is common to calculate the weight of vessels on the old plan, as equal to their register tonnage, which the Author will adopt as

as to comparison. The barque Annesley, by a careful and repeated calculation, when launched, weighed eighty four tons, being not one-third of her register ; the water she removed then, justified the estimate, being 2 feet $10\frac{1}{2}$ inches, medium fore-and-aft.

The Hope, ocean steam packet, by calculation when launched, weighed rather less than 11 tons ; she measures, (including her mid-channel) 56 tons, not $\frac{1}{5}$ of her tonnage. She drew 16 inches water on a medium when launched, with her engine on board, weighing four tons, which corresponds to the weight assigned her.

CAPACITY.

THE form of a vessel upon this system has been found most suitable for stowage, and cabin conveniences, every spot being profitably occupied. The solidity and compactness of her structure afford no harbour for rats, mice, or other vermin, matter of no small consequence ; and should they pay a casual visit, to commit their depredations upon the stores and cargo, they may be easily ejected.

The exclusion of timbers generally gains from 9 to 10 per cent. actual space.

STRENGTH.

THE massive main timbers of vessels, built upon the old method ; the numerous frame timbers, weakened and tending to decay by the wedge pieces ; assuming the form, without possessing the power of the arch ; attached to the external planking, yet leaving alternate vacancies, and rather depending on it, than affording support ; with the profusion of metal, absolutely necessary to keep the whole together, afford presumptive proofs of weakness ; besides which, the structure is subjected to the continual strain of all the timber

fore-and-aft, acting as a loaded lever against the centre fastenings, knees, braces, &c.

The new system is free from all these sources of self-destruction. The plank is not injured by steaming or straining, it being a principle of the system, that what cannot be bent with facility in one thickness shall be laid on in two, which adds to the strength without increasing the substance.

A vessel thus constructed presents an arch in every direction; her texture is the strongest possible for wood and wood to be put together, and her form the strongest, adapted to sailing. She is so bound throughout, that every plank and every trenail participate in, and thereby diminish to the lowest degree, the effects of every shock and pressure.

In the event of a vessel on this system being driven ashore, if it be supposed that the dead wood and keel may separate, the body of the vessel will remain water tight, and the more easily drive into shoal water or be got off, in either case to the security of the crew and cargo.

Numerous instances have taken place of vessels running foul of each other, when one has gone down, sometimes both.

Vessels, on the contrary, of this construction, unless absolutely run down by an overwhelming weight, could not be materially injured, should the stem of one come on the waist of the other, as the surrounding water would be displaced ere the arched texture of the vessel would be broken.

It is acknowledged, that the present square stern is the weakest, as it is the most expensive part of the vessel; but to compensate for weakness and cost it is said to be elegant.

Flush decks have been generally adopted on account of superior strength, although they are acknowledged to be continually wet in bad weather, but in this system such is not the case; every

vessel may be built with the comfort of good cabin room and dry quarter-deck, without the smallest sacrifice of strength.

As observation and fact are the best supporters of reason, it may therefore be proper to state here some circumstances respecting the schooner and other vessels thus built.

When the hull of the schooner *Annesley* was complete, the distance between the keel and the plank on which the centre block stood was accurately measured, the vessel was braced from the sides to prevent an overset, the shoars struck, and all the blocks removed excepting one forward and another aft; thus suspended upon her extremities, a variation of seven-sixteenths of an inch only took place, and the greatest part of that was justly attributed to the rise of the plank when relieved from its former pressure.

She was launched ready for sea, and proceeded to Bangor, where the tide left her dry on a very hard bottom; through inadvertence she had not been secured upright, and she fell on her bilge, having in her hold fourteen tons of cast guns for ballast. Her keel was sixteen inches deep in midships, which rendered the accident a severe trial of strength, but she was not strained, or in the least injured.

On her first voyage to Liverpool, she lay aground outside the docks, deeply laden, for the purpose of exhibition, without the least appearance of straining. On returning to Belfast, it was found that the paint and putty, with which her bottom was finished, did not properly adhere (it having been laid on green wood, in winter), designing therefore to lay her on the blocks, from whence a vessel had removed the same tide, it was found, on the water leaving her, that she was suspended on two blocks in the centre, within the distance of four feet, that had been displaced by the removal of the former vessel. At the time she had some tons of cargo on board, but not the slightest appearance of strain did she exhibit.

The schooner was chartered in September 1818 for Bourdeaux, she had 22 tons of pig lead on board, which was very injudiciously piled up on the platform, in the centre of the vessel. In a heavy gale of wind in the Channel, a sea struck her under the bilge, and threw this body of lead to leeward, which laid her lee comeings under water. In this alarming situation she wore, and got on the other tack, which allowed them to place the lead more securely. The shock of such a dense weight thrown violently on her side, would probably have started the planks of any vessel of the ordinary construction, and as inevitably must she have foundered; whereas, the schooner sustained not the least injury. She arrived all well at Bourdeaux, and returned to London deeply laden with a cargo of dried fruit, which was landed in the best condition. She behaved equally well in a trying winter voyage to St. Michael's, out and home.

A letter from the Captain who chartered her to Seville, and took her from thence to Gibraltar, and returned to Seville, speaks highly of her; from thence to Dublin, Waterford, and Wexford, where he shamefully took in so weighty a cargo of provisions, as nearly sunk her, and would probably have occasioned the foundering of any common-built vessel. She kept the sea during continued gales of wind when other vessels sought shelter in port, but at length was driven into Margate Roads with the loss of anchors and cables; she arrived safely in London, and discharged her cargo, somewhat damaged from the seas she had shipped, by having part of her bulwarks and staunchions carried away.

Very severe and unfounded remarks were made respecting this damage, upon which an average loss was recovered in Lloyd's Coffee-house. It was even asserted, that the schooner was not sea-worthy; an assertion instantly rebutted by an appeal made to one of the Surveyors of British shipping, who had examined her. It is worthy of note, that at this very time, one of the finest ships

of the port of London came in with above 100 hogsheads of her sugar cargo washed, some of them clean out, yet not an idea existed against her sea-worthiness.

Upon the strictest survey, no strain appeared anywhere about the schooner; and midst all the heavy gales, and the sea continually breaking over her, deeply laden as she was, she only carried away part of her staunchions and bulwarks.

Having been sufficiently exhibited, the schooner was sold, with all the force of prejudice against her, to a Gentleman who was fully acquainted with every iota of what was said respecting her in the Coffee-house, and her log-book was given to him. After the purchase he was so wrought upon by reports, that, repenting his bargain, it was left to himself to cancel the sale; but he was eventually so perfectly satisfied of the untruth of all he had heard to the schooner's disadvantage, that he went to sea in command of her himself.

He has owned and commanded some large and fine ships built on the old method, and he was evidently something doubtful on this occasion. He went to St. Lucar, where the schooner encountered very bad weather, and was driven on shore by a sudden and heavy flood, which, however had not the slightest effect upon her, and he returned to London, declaring that she was as fine a sea-boat as he ever was in, and that he would confidently go any voyage in her.

To form a tolerably just conception of the strength of vessels thus constructed, let us consider the actual strength of the fibres of the woods employed, from experiment.

Mr. Smart, of the Borough, Southwark, some years ago fixed, horizontally, the two ends of a lath of Baltic fir $\frac{1}{8}$ of an inch in thickness and $2\frac{1}{2}$ inches wide in a frame, where it still remains for the inspection of the scientific; it has carried a weight of 270lbs. Its power in vertical suspension is vastly greater.

Mr. Hookey, of Woolwich yard, informed the Author, that an

oak turned pin of $\frac{3}{4}$ inch diameter, suspended a weight of 1200lbs. by an experiment made by him and other Gentlemen. These facts, shew how vast a power is required to rend asunder the fibres of wood, and will give some idea of the fore-and-aft courses of planking, when united as they are, with the transverse courses and with each other, combined in a form capable of the greatest resistance consistent with sailing; and will prepare the mind of the reader to receive, without hesitation, the trials of strength this system has been exposed to, and give credit for what may be modestly inferred from these facts, in cases that have not yet occurred, but which all vessels are liable to.

Several open canal boats were built at Deptford 70 feet long, 7 feet wide, and 3 feet 6 inches deep, consisting of four courses; two fore-and-aft of $\frac{3}{4}$ inch fir, two transverse of $\frac{3}{4}$ inch oak inside, in succession, with paper between; making 2 inches through.

One of these boats, her length being ten times her width, was suspended on her two extremities; a line was previously strained from stem to stern, and an upright fixed in the centre and marked, from which she only sunk in the middle $\frac{1}{4}$ of an inch. A block was then placed midway, from stem to stern, and the blocks fore-and-aft were struck, permitting her to bear entirely on the centre one; by the same line and upright the middle rose $\frac{1}{2}$ inch only. These simple experiments are submitted to be conclusive, in proof of the strength of the structure of vessels on this system.

As strength in the construction of large vessels seems to have been the principal improvement to which the minds of men of talent have lately been directed, and which governments are most desirous to obtain, and in which they have been eminently successful, considered as improving the old principle, and which improvements in all their tendencies, gain in a partial degree, and at vast expense, what is here obtained on the first principle, in the most simple manner; the utmost security to the stability of the

component parts; for in this system building is bracing; and bracing, building throughout.

Would it not be of use, to put the different systems to a simple, cheap, and effectual trial; by the construction of a section of the central part of a vessel on each plan, formed to the usual proportions, and submitted to various experiments, in order to prove their relative strength? These sections would also answer the valuable purposes of shewing their comparative powers of repelling a shot, liability of splintering, and facility of repairing

It is an acknowledged truth, that no body is stronger than in its weakest part, "or that partial strength is general weakness." On these principles the Inventor affirms, that the timbers used in constructing a vessel on the old method, by which it is conceived to be necessary to build up two courses of planking, parallel to each other, for the purpose of keeping them in their relative situations, at the same time keeping them apart, so as to lose all the advantages of cohesion and mutual support; is so much of an actual drawback from that strength, which would otherwise accrue by the intimate union of the outer and inner courses.

In a trial of central suspension, the whole weight of the timbers, with their vastly increased leverage, as they recede fore-and-aft from the centre of bearing, will be found to add to the weakness of the old method.

This infirmity limits the size of building on that principle, to the present first rates. And notwithstanding all the judicious supports lately afforded by ingenious men, the largest class of vessels remain the weakest, when put in competition with those of an inferior size, in equal circumstances; thus giving assurance that the most extensive knowledge in science and mechanics, will not furnish resources to supply the radical defects of a first principle. If one of the simple shells in the new system were to be timbered, bolted, and braced, according to the latest improvements, it would

only tend to obstruct, lumber, and weaken her, and the more numerous and weighty the bolts and timbers, the sooner would the structure give way, in a trial of extremity.

Upon this ground, the Author will merely take the planks allowed sufficient for a vessel on the old method of building, and by sawing them into suitable thicknesses, and losing the sawgate, which is about 10 per cent. will undertake to construct a vessel stronger than any built in the usual manner.

To illustrate, in as fair and clear a manner as the Author is capable of, the relative strength of the largest vessels built on the usual, and new method, recourse must be had to hypothesis, as it will be thought unnecessary to put it in practice. Suppose a model to be made of the Prince Regent, built at Chatham, (a vessel as strong, and every way as complete as probably the principle she is built on, will admit of) she is 200 feet extreme length, and 50 feet beam. The model to be 1 foot to 10, would make it 20 feet long, and 5 feet wide, with depth proportionate. This vessel to consist of the same number of timbers, joints, and fastenings, the same number of planks, bolts, &c. all proportioned exactly to the scale, as in the Prince Regent, would be found precisely as tender and frail, and would require as many supports when building to prevent racking, as much truth, care, and attention, in forming a cradle, and in launching, to prevent injury, as the Prince Regent herself. A model on the same scale, built from a vessel of the same dimensions, according to the new system, and confined to the same restrictions, as number of courses, length, breadth, and thickness of the planking, number and size of trenails, &c. &c. in every particular, would in reality, be as strong as if the choice of proportion was allowed. The only difference would be, in the great expense of time which the work, being so minute, would occupy; and yet this model could be made for half the price of the former. A model thus made, the Inventor affirms, would be

actually stronger in its texture than a boat of the same dimensions built in three courses, and would bear suspension on her two extremities, filled with water, without sustaining injury, or might, when light, be rolled into the water without damage, except to the bulwarks and deadwood.

TIGHTNESS.

THE best built ship of the old method will strain and open seams in extremity of weather, but the vessel on this system, if tight from the stocks, will remain so, and having no spaces to strain to, will bring the united strength of her entire structure to resist the violence of the winds and waves.

Those who have maturely considered the system will credit the assertion; and those who have sailed in vessels of the system, know that such is the fact.

Ordinary attention to this peculiar mode of construction will render vessels water-tight; and it cannot be readily conceived, how or where water is to find entrance, unless it be from the unpardonable omission of a trenail, or neglect of the caulker and inspector, which may always be detected by a faithful foreman and clerk of the works, seeing to every plank in each course.

Launch the vessel sound from the stocks and she will continue sound.

An erroneous opinion conceived by the first builders and workmen, that the number of courses alone would prevent the access of water, without the ordinary means and attention, has produced neglect in some instances, which has been greatly magnified, by those whose prejudice against the system was rivetted by interest.

The following manner of adhesive papering the Author has practised, and found it cheap, expeditious, and effectual. For the inner courses, take well boiled flour paste made stiff with allum

water; lay a coat of this on plain strong patent paper; give also a coat to the planking; when the sheets appear dampened through by the paste lay them on the work, pressing out the air, and causing them to adhere in every part; when dry, give a coat of well boiled stuff made of pitch and tar, or of lime and tar boiled, sufficiently hard to resist the touch, that the succeeding course may be cleanly laid on. On the last transverse planking, after caulking and paying, he has laid on a coat of stuff, so hard when cold as to resist a firm touch, and applied plain paper, then took heated hand irons (such as women use), and passed the iron from the centre of the sheet to the extremities, thus heating the stuff to make it adhere, pressing out the air, and laying it all flat and united with the course.

Great attention should be paid that the sheets closely adhere at the overlay of every joint; on this course of paper is laid an uniform coat of well boiled stuff.

Little ingenuity is required to render these vessels perfectly tight, but the utmost attention and fidelity are required to inspect every course closely, to observe if there be any shake or rent in the plank from careless driving of the trenails, or if any be omitted, and to have every crevice filled by caulking, or a putty made of linseed oil and lime, or other cement.

In vessels built entirely round, as the latest is on this system, with bulkheads, on the same principle in two courses, with paper between, and caulked all round, before the fillets are laid, which gives the hold the form of an elliptic barrel (but much stronger, having the heads defended), with the fore-and-aft courses for staves, and the transverse for hoops, and likewise bearing a resemblance in proportion of stuff, one quarter of an inch to the foot athwart in substance.

This is observed, to justify the Author's hope, that in a short period, builders will be found on the new system, to warrant their

vessels not to make water at sea, in a voyage to the West Indies and home.

DURABILITY.

IN this system, where the necessary attention is paid in building, the great cause of decay is prevented: the alternate access of air and water, which by expanding and contracting the fibres, tends to destroy them. And as a vessel on this plan may be built without the least sap or decayed wood, and may have all her planks well seasoned, and covered with oiled or tarred paper, canvas, or the most approved cements, it may be fairly inferred she will last above double or treble the time, of any vessel built with the same quality of materials in the ordinary way. That the timbers generally decay before the plank, is universally known; having spaces between in which filth accumulates, and operates as a manure, to promote vegetation or fungus; nor is an effectual method of curing large timber without injury yet practised.

William Chapman, Esq. M. R. I. A. civil engineer, &c. when giving his approbation of the system, on viewing the sailing barge of Messrs. Brindleys, was pleased to allow the Author to give to the public as his opinion, that the new system was not so liable to decay as the present, and admitted of the most effectual methods of preservation. As this Gentleman has wrote a highly esteemed treatise on the means of preserving timber, his may be considered as valuable authority.

In addition it should be remarked, that the inner courses of this manner of building are kept in an equal medium of heat and cold, and surrounded with matter congenial and preservative.

The expense attending a thorough repair of vessels built with detached timbers, amounts frequently to as much as would build one of the same dimensions on the new system; therefore, it might

be well for ship owners to consider which is the best expedient, to repair, sell to the ship breakers, or build on a sound, cheap, and durable principle.

BUOYANCY.

WHEN it shall be duly considered, that the planks used in this system may be thoroughly seasoned; that water is completely excluded and the wood not soaked; that all the courses together only make about $\frac{1}{7}$ more than the thickness of the outer and inner planking of the present mode; and that heavy timbers and enormous weight of metal are utterly discarded; the conclusion appears just, that such vessels will not exceed in point of buoyancy half, or a third of the general weight of those constructed in the ordinary way.

The preceding accounts will shew that the comparative weight of the vessels on this system is less than in a ratio of one to two, and might be fairly stated in general as one to three, as regards the old method.

It is a fact to be borne in mind that the barque Annesley, registering 256 tons, weighed when launched at Deptford eighty-four tons, and that her draft of water confirmed it, being only 2 feet 10 $\frac{1}{2}$ inches; and that the Hope, ocean steam packet, with mid-channel, measuring 56 tons, weighed only eleven when launched; she being only $\frac{1}{8}$ of an inch to a foot of width through, making 1 $\frac{1}{4}$ inch entire thickness, yet accidentally furnishing a proof of her strength, that requires to be attested to obtain general belief.

SAILING.

Plate IV. B. fig. 6, is formed by two equal segments of a circle, and is the figure allowed by men of science to pass the quickest through the water, in opposition to all others of the

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same weight and dimensions with equal impulses, as proved by repeated experiments.

The principal difference between a vessel for burthen or sailing, consists in that form being fuller or finer fore-and-aft to a certain degree. The fig. A, furnishes the principle, that a regular form, equal fore-and-aft in entrance and delivery, with a horizontal keel, is neither fit for burthen or sailing, as wanting stowage and bearings; yet still preserving the principle, but altering the figure, we obtain both, as in the dotted line C and B.

In a vessel of the regular elliptic form, her midships being justly assumed the centre of motion, the relative position and proportions of her spars, rigging, and sails, may be justly determined; her trim should be such as to bring her on an even keel, with a moderate breeze of wind aft; and her fore-and-aft sails so disposed in direct sailing as to take her helm precisely mid-ships: nor will she require the least variation of helm in going free or close hauled, blowing fresh or moderate, for sailing upright, or careening, the same equal water line fore-and-aft is shewn; only the partial heave of the sea, tide, current, or such bias, will render it necessary to shift the helm.

All other vessels that are unequal fore-and-aft must alter their water line when careening, and vary their trim, which requires a variation of the helm; consequently their way is obstructed.

The upright deadwood fore-and-aft, whilst it forms the greatest possible opposition to leeward, serves to conduct in the most direct and powerful manner the water to the rudder; consequently, the least extent of rudder is required, and the least variation of the helm sufficient to alter her course. When on board the schooner, in moderate weather in the Channel, with steering sails set, going at the rate of five knots, the Inventor carefully adjusted the helm, secured it stationary, and walked the deck, occasionally observing her course, and found she did not vary $\frac{1}{4}$ of a point in

an hour ; and he feels confident the vessel sailed a greater distance in the time, than if the helm had been in hand. He has frequently felt a painful sensation by observing the helm moved, and to a degree unnecessary, and again reversed to correct it, sometimes from negligence, or a habitual restlessness frequent in sailors. To obviate which, a premium might be given to those who would steer their time with the least variation ; and a moveable stand made to screw to the deck, in moderate weather, or a fixture attached to the binnacle, to steady the helm when adjusted. By these means, if the vessel is in trim, she moves direct by her sails to the utmost advantage ; her rudder becoming merely the termination of her deadwood aft, and only moved to alter her course, or oppose a partial influence of currents, &c. In a run of 24 hours, this method will be found to make a great difference in the advance of the vessel, as the Author has repeatedly observed in coming up with distant vessels, and leaving them, from the manner adopted in steering the schooner.

The forms of fish and aquatic birds, have been often alluded to as justifying the build of particular vessels ; they, although perfect in their design, can furnish but little assistance in the pursuit of nautical knowledge, in the present state of navigation. To say a vessel sits like a duck in the water, gives us the idea of stability, and being a good sea boat ; and thus far the form corresponds with the truth of experiment ; and I believe the water line of the duck will be found nearly a regular ellipsis: if any fuller forward, it is to support the weight of the head and neck. In the pectoral fins of fishes, there will be found a close affinity to the deadwood in the new system, in their being both upright, and both serving to preserve the course direct of the object, whether the impulse to velocity is performed by the vibrations of the fish's tail and motion of the side fins, or produced by the sails of a ship.

Thus fowls and fishes jointly considered, in whatever can respect

the sailing of vessels, will be found to correspond with the results of a variety of experiments made by the Inventor, and supported by facts.

Relying on the experiments and facts displayed in the course of this work, as far as they extend to produce the conviction, that uniform bodies are best adapted for strength, stowage, and sailing ; the Author will proceed to the proportions of vessels on that principle.

The well known truth of the increased debility of building long vessels with detached timbers, has limited regular trading vessels of considerable burthen to at most four times their breadth of beam for their extreme length.

As the strength of the new system will confidently admit of vessels being built of ten breadths for entire length, and by increased bulk give additional security, there is ample room for experiments of proportion.

To recur to the first principles of fast sailing, the longest possesses them to the greatest extent ; allowing the easiest curve at entrance, the longest floor, and most gradual and freest delivery. For depth of hold, the Author would not exceed the half her width for merchant vessels, and in all have their bearings low, (as shewn in the sections) which gives stability. A vessel of six breadths (not to be extravagant at first) thus built, having an ordinary depth of centre keel, full gripe, upright deadwood and perpendicular rudder, aided by side keels of proportioned depth and length, would carry sail with a swept hold, if rigged judiciously with masts and spars in numbers and proportion.

The Author recommends to builders on this system, the perusal and study of Capt. Gower's description of the manner he rigged the *Transit*, which vessel was five breadths of beam in entire length, and whose superior sailing and working give sanction to this proportion, and to his peculiar manner of rigging.

A vessel of those proportions affords room for a vast spread of canvas with light and low spars, consequently the least expensive in first cost, in wear and tear, and the most secure. Also in building the hulls of those long vessels, the curves fore-and-aft are the more easily bent to ; and the great proportion of the long waist or barrel, which is built with the utmost ease and facility, and to the greatest advantage of stuff to the builder.

To give some conception of the advantage of building such vessels, I shall only hint at their use in the coal and Petersburg trade ; leaving the consideration to ship owners and builders, as they may be particularly engaged, how far the proportions will suit their designs.

From calculation justified by the burthen of coals actually brought from Leith by the barque *Annesley*, a vessel constructed on the system, (allowing $\frac{1}{4}$ of an inch to the foot in width, to be the proportion for thickness through,) of one hundred and twenty feet extreme length, twenty feet greatest width, and ten feet hold, will carry upwards of three hundred tons, drawing eight feet six inches water, allowing her centre keel to be six inches deep in midships. This vessel with her full gripe, upright dead wood and side keels, will carry sail stiffly without ballast, hold a good wind, and sail and work in a superior manner ; nor, by the laws of gravity, could she lie with her masts horizontal if prostrated by a sudden and heavy squall, but would immediately right when put before the wind ; nor could she take in water to a dangerous extent when her hatches are secured, being a perfectly water-tight elliptic barrel between her fore-and-aft bulk heads. Such a sized vessel would be well adapted to both the above mentioned trades in general, but is only given here specifically for proportion and calculation, to serve as a basis to estimate the advantages that may result from its adoption.

ELEGANCE MUST CONSIST IN THE PROPRIETY OF FORM.

IN order to obtain a correct judgment respecting the elegance of two vessels, the one sharp at bow and square at stern, and the other a simple ellipsis, each finished in the best manner the respective plans will allow ; it were desirable to submit them to the observation of twelve persons of plain understandings who never saw a ship, or who had not previously considered the subject. Can it be doubted, that the beautiful symmetry exhibited by the ellipsis would prove far more attractive?

Spheres and ellipses have been objects of admiration with the untutored, as well as with those whose minds have been refined by science and taste ; it seems, therefore, surprising that square sterns should be conceived by many to present the most beautiful forms, and that there are persons, who, allowing all the advantages of the system, are yet so wedded to long habit, as to propose building fictitious square sterns for appearance sake.

The Inventor is not unfriendly to decoration consistent with common sense, but he conceives, that true taste will not permit mere ornament to interfere with, much less to destroy, simple elegance, which teaches to avoid all unnecessary projections, as only tending to increase the damage arising from vessels running foul of each other and obstructing the way of the ship, while they are also obtained at great expense, and attended by weakness and danger.

In chaste civil architecture, any deviation from the line of simplicity and truth is considered erroneous ; why not so in naval architecture, where it is not only wrong, but absolutely dangerous ? These considerations, carried into effect, would produce order and fair proportion throughout ship building. And whatever shape cannot be justified by such rules, must appear deformity to the accurate observer.

On this ground the ellipsis is offered as the most simple form ; combining elegance, strength, capacity, and swiftness.

SAFETY.

It has been previously shewn, that a vessel faithfully and judiciously constructed on this system, cannot strain or make water in a gale of wind, owing to the perfection of her form and texture ; and she is as superior from her buoyancy : hence the cargo will be more safe, and the crew more healthy.

Facts have already proved, that much less ballast is sufficient even where the proportions are the same, to enable such a vessel to carry sail, than one built in the usual manner. This is also self-evident, from her upper works being lighter, which operates upon the same principle as lowering the deck guns into the hold to lessen the labouring of the ship. Every one of those vessels may be made a life-boat, by cross planking, papering, and caulking the bulk heads fore-and-aft, thereby rendering each perfectly water-tight, and any one compartment would be sufficient to float her.

It may be demonstrated, that without any sacrifice of sailing, vessels, which could not be overset, can always be built in this manner ; they may be thrown on their side by a sudden gust of wind, but would immediately right again upon easing off the after sheets, and putting before the wind.

There have been many instances of vessels missing stays, getting stern-way in a heavy sea, and going down stern foremost, from their being remarkably lean aft : this could not take place in one of this form and construction.

Frequently the causes of ships foundering at sea, as starting a butt, loosening the frame or stern-post, the decay of iron

fastenings, and the loosening of copper ones, &c. cannot be apprehended here.

Shipping a sea is a circumstance to which those vessels are also less liable, and if stranded, even among breakers, still the crew and cargo may be safe; for at all times, they oppose the whole combined and united power of the structure against every general or partial shock, and will bear the rebound like a well hooped cask with the heads defended from injury, when ordinary ships would break their timbers at the first shock.

In tremendous gales at sea those vessels are always lively, and only suffer violent agitation.

At anchor they will ride dry, when other vessels are pitching bows under.

REPAIRS.

SHOULD the outside of a vessel built on this system, decay, or any partial injury take place above water, it is easily repaired by ripping off the piece injured and laying on a sound piece; thus vessels may be renewed for many years at a small expense.

A force that would penetrate the number of courses of which these vessels are composed, would tear the jointed timbers of ordinary ships out of their places, and make a wreck of the stoutest of them. However, suppose as an injury, a hole made by a sharp-pointed coral rock in the bottom, or by a large shot through her side—being unobstructed by metal, she is repaired in either case with facility. Again, should she ground upon the peak of her anchor, it would hardly perforate a bottom formed on the proportions recommended by the Inventor, but it might indent the outside plank, and render it necessary to lay in a shifting piece.

Plate V. fig. 10, shews the repair of part of a vessel composed of five courses, A. A, the extent of the supposed injury. Rip off

the outside damaged plank sufficient for a shift to B. B. and the injured fore-and-aft inside C. C. ; then cut away from inside and out, bevelling from the centre all round, as shewn at A. A. and insert two graving pieces D. D. D. D. the shaded part shewing the grain reversed.

The form of the graving pieces must be governed by the shape of the fracture, square, circular, or irregular, so as to cut away the least possible portion of the sound wood. They will press in every part against each other, and against the side of the vessel, like a wedge. A bolt, if thought necessary from the size of the fracture, may be passed through the centre of the graving pieces, to unite their strength inwardly and outwardly. Caulk those firmly, pay and paper them, and relay the outside and inner planking carefully, and the vessel will be perfectly tight and strong. All this may be so readily performed, that every vessel will be found to furnish tools and men fit to do it.

If an injury happens at sea, and the outside cannot be got at, it may be readily and safely repaired from the inside.

The precise state of the vessel, as to general soundness, may be known at all times, by boring holes below and above light water-mark, which may be afterwards stopped with compressed trenails of fir, propped with oak.

In the old mode, much uncertainty exists respecting the actual state of the vessel, which has often proved injurious to ship owners as a doubtful transfer of property, to underwriters in regard to security, and to the crew in point of safety.

Heavy expenses have frequently been incurred by repairing upper works in consequence of a survey, and the vessel, when more laid open in the course of the repair, has been eventually condemned ; yet, no doubt, the surveyors acted with judgment and integrity, the fault being in the method of construction.

BILGE OR SIDE KEELS.

ALL vessels may be rendered capable of holding as good a wind as the sharpest do at present, by means of bilge or side keels, which are, in fact, fixed lee boards.

For long, low, and flat vessels, barges, &c. they will be found of great advantage in sailing when light, whilst they stiffen the bottom in the most effectual manner, and enable the vessel to carry more sail, and lie ashore easy and upright.

A principal object of the Inventor's consideration has been to unite an easy draught of water with the power of holding a good wind, for general safety at sea, and for bar harbours and rivers; and from the known truth that water is with more difficulty removed, as the depth of the immersed body increases, it has been his study to keep his vessels as near the surface as he could, consistently with other advantages. For this purpose he suggested the advantages of bilge keels to Messrs. Brindley, who were the first to adopt them in the barge *Safety*, which enabled her to hold a steady and direct course under full sail in a stiff breeze, when drawing only 15 inches water.

The barque *Annesley*, when launched, drawing only 2 feet 10½ inches water, had 52 persons on board. As usual in such cases, they rocked her, but their united efforts only caused her to vary about 17 inches from the level; this uncommon stiffness was principally attributed by those present to the side keels.

On her first voyage, this vessel of 256 tons register took in sixty tons ballast, drew only six feet water, and in a squall off the Humber, carried away a new fore-top-mast, a very fine spar.

VESSELS OF WAR.

It is in such vessels that the most valuable principle of the New System is required in the greatest degree, namely, strength, obtained by the most intimate union and combination of wood and wood to the utmost possibility in the method of construction, and in the degree of strength in the repetition of the courses.

In firing heavy ordnance from vessels on this system, it only causes a general vibration, proving that the whole structure is united in sustaining the shock. In ordinary vessels the recoil is almost entirely sustained by the fastenings and timbers immediately connected with the gun.

In repelling indirect shot, the whole elliptic figure is most favourable to ; and in resisting point blank, the numerous courses prevent their penetrating to a great degree, as a quire of paper is known to resist a musket bullet.

In receiving shot, the few that pass through will be so much spent from the opposition they met with, and the compactness of the body, as to cause few, if any, splinters, which are found so destructive of life in the present method of building, and may be most effectually plugged from the inside, without risque or exposure.

Thus a vessel may be riddled but not sunk.

Large vessels of the old structure are not allowed to take the ground, as they seldom or ever do so without material injury ; but it is evident, from preceding statements, that the largest vessel on this construction may be laid ashore with as much safety as the smallest.

Thus repairs might be effected, in many instances, where a dock is absolutely necessary to vessels built with detached timbers, and which has occasioned them to be, in some instances, at imminent risque, transported across the Atlantic.

Vessels on Discovery, especially in the Polar Regions, thus formed and constructed, would possess the greatest power of resistance to the formidable dangers they are liable to, and admit of being most securely fortified by metal circular port holes and ports.

CIRCULAR PORT HOLES.

WHAT we often attribute to propriety of choice, proceeds from necessity ; therefore square ports are as general as vessels built with detached timbers.

In the New System, the propriety of the figure requires only to be considered.

As the more numerous and larger the openings are in any vessel, she must be the weaker.

On this principle, the Author suggests the advantage of circular ports, whose diameter is equal to one side of the usual square port, by which is saved about one-fourth of the space, yet allowing the vertical and horizontal range the same extent as if square ; and the Author believes, in no instance would this form interrupt the gunner's design. Thus gaining strength, and elegance of appearance from its symmetry with the gun.

In building a vessel of war of equal number of courses, when half her planking is finished the builder should mark out her ports, (if circular), and through the centre of each bore an augre hole direct, to determine the centre in and out ; this filled up will serve to describe the inner and outer circle, allowing for the bevel, as shewn in Plate VII. fig. 7, when the inner ports may be accurately sawn out by two men, marked and numbered. At this period the moulds that may interfere can be safely removed.

When the outside planking is finished the inside ports may be replaced, the centre pin driven out, and the same augre passed

through, to furnish the corresponding centre on the outside ; these accurately sawed to the lines, the entering holes of the sweep-saw filled up, and the saw marks cleaned off, the edges of the ports and holes may be plentifully saturated with hot stuff to penetrate the ends of the wood and fill up any crevice, and finished with a hard and smooth cement. Over the edges of the ports may be laid handsomely a coat of felt, to fill the space of the saw gate, and allow the screw bolt in the centre to press all to a full bearing ; when the ports are shut, bolted, and caulked. In this manner vessels of war may carry their ports under water with perfect security.

What can be so interesting to a great naval power, as to find it proved, by the unquestionable evidence of fact, that the hulls of vessels of war of immense strength and duration, can be built at two thirds their present cost ?

In a case of extreme emergency, as materials and workmen could be readily procured in every considerable sea port at the same moment, the rapidity with which an entire fleet might be built upon this system, would appear incredible to those unacquainted with its principles.

The prices of building the hulls of vessels of war, small and great, at different periods of ten years during the last war, are stated as varying from £12. to £30. per ton ; this was owing, in a great measure, to the difficulty of procuring adequate timber, which could not occur in building on this system.

Depots of timber for the use of Government might be kept up, by annual supplies equal to the demand, as the stock would almost entirely consist of wood not in a perishable state, but in merchantable plank ; the interest of which would be paid by the increased value of seasoning ; and allowing those longest preserved to be first used, a regular succession of well cured timber would be kept up. If at any time a surplus arose, it would command the current value. From the order of such a system, a correspondent regularity could be observed throughout.

The species of wood for building having been determined, correct estimates may be made of the quantity and dimensions for sawing. Whether that be performed manually or by machinery, there should be standard gauges made for all the different thicknesses required, not depending on nominal dimensions ; for sawing with precision, saves the timber as well as time, and produces sounder and neater work, it is therefore essentially necessary to be attended to.

For government depots, the vicinity of salt water would be preferable, in which to immerse the planks, as soon as sawed, for two or three months, or more, according to their thickness ; when taken out they should be assorted and piled under cover, placed on parallel bearers, at the necessary distances to keep them straight and apart, for free circulation of air. The planks being thus arranged, of the same length, breadth, and thickness, those fit for the purpose required can be taken readily and without confusion ; by using planks of the same width and thickness, differing only in length for the shifts, very little sacrifice of stuff is required, and the utmost regularity is preserved throughout the construction.

FISHING VESSELS.

COMPANIES engaged in the various fisheries, having had one vessel built from an approved model, will find the same moulds answer for many more in succession.

In the north and south polar regions the advantages would be incalculably great ; for vessels on this principle may be doubled in any and every part course over course, thus producing the greatest conceivable power of resistance to opposing forces, affording greater warmth and personal comfort to the crew, and carrying much larger cargoes with less draft of water.

CANAL BOATS, BARGES, AND LIGHTERS.

THESE possess every advantage from the new system, viz. buoyancy, vast strength, and speed; circumstances apparent to every judicious observer of its principles.

Many barges and canal boats have already been built; in every instance they have proved the excellence of the system, carrying immense burthens at very light draught of water, and bearing excessively ill usage from the labouring men of the several trades in which they are employed, who have an idea they will be injured if those boats be adopted.

EXPERIMENT I.

Plate VII. fig. 4 and 5. Two pieces of deal wood were prepared, each 20 inches long, 5 inches wide, and $2\frac{1}{2}$ inches deep. fig. 4 had each end cut away from the top, inclining to the bottom horizontal plane, at an angle of 45 degrees. Fig. 5, had each end vertically cut away from the cutwater and stern post lines to the sides, thus inclining outwards at an angle of 45 degrees.

The two wedges cut off from each end of 4, were exactly of the same dimensions as the two wedges cut off from each end of 5; consequently 4 displaced the same quantity of water as 5.

A cavity was made in each of these pieces, and an equal weight put in, as ballast, to sink them exactly to the brim in the water; but some slight slips of wood were previously placed all round the cavities, to prevent the water coming in.

In this state, 4 may be considered as a barge being cut away all

from the bottom and none from the sides, and 5 as a canal boat, cut away all from the sides and none from the bottom.

Almost all vessels are of one or the other of these two forms, or a compound of both, more or less rounded off.

This experiment was made to ascertain which of these extreme forms is the better calculated to pass through the water with the greatest speed and safety

These two pieces were drawn through 14 feet of water, they were started together at 12 different times, and the distance which one gained upon the other was noted each time. The average result was, that 4 gained half an inch upon 5 in passing the whole length.

In every instance 4 kept a steady course, while 5 sheared ; 4 was dry throughout, but 5 frequently took in water.

The practical inference to be deduced from this experiment is, that for the sake both of speed and safety, a vessel ought to partake more of the shape of the barge than of the canal boat, by being made on a regular curve from the bottom, and full at the bows and quarters.

EXPERIMENT II.

Fig. 4 and 5 were repeatedly drawn *broadsides* through 8 feet of water, and performed the distance in equal times ; the resistance to lee-way seems, therefore, equal in both.

EXPERIMENT III.

Two models, called Sharp and Merchant, were made on a scale of $\frac{1}{4}$ inch to a foot ; Sharp, on the most approved figure of the old method, Plate II. fig. 6 ; Merchant, upon the elliptic form of the new system, fig. 7 ; both were 20 inches long and 5 inches wide ; Sharp $4\frac{1}{4}$ inches, and Merchant $3\frac{1}{4}$ deep from the bottom of keel to gunwale. Sharp's keel from the straight rabbet was $\frac{1}{2}$ an inch deep ; Merchant's keel midship $\frac{1}{4}$ of an inch ; besides which, Merchant had two side keels 12 inches long, and ranging with her

main keel, so as to take the ground upright, making their depth full $\frac{1}{4}$ inch inside and $\frac{1}{8}$ outside measurement. Sharp's light draught of water was $1\frac{1}{8}$ inch forward, and $2\frac{1}{4}$ inches aft. Merchant drew $\frac{1}{4}$ inch fore-and-aft. Sharp, when loaded with 3 lb. 7 oz. drew $3\frac{1}{8}$ forward and $3\frac{7}{8}$ inches aft; Merchant, with the same weight, was $2\frac{1}{8}$ inches fore-and-aft. The height of masts from deck in both was $17\frac{1}{2}$ inches, and the end of each yard-arm was $5\frac{1}{2}$ inches from the centre of the mast; the height of the yards from deck being 11 inches.

The light weight of Sharp with mast and yard was two pound (avoirdupois), that of Merchant was 1 lb. $6\frac{1}{2}$ oz.: that the water removed might be the same in both, weight was put into the Merchant equal to their difference.

These models were drawn through the water, as shewn in Plate VII. fig. 1, observing each time to change the model to the different pulley to prevent a bias. On an average of many trials with equal weights their speed was equal.

EXPERIMENT IV.

To determine the respective ability of carrying sail. The models Sharp and Merchant, both light: Sharp had $\frac{1}{4}$ of an oz. suspended by a thread 8 inches long, at the yard arm, which made an angle of $51\frac{1}{2}$ degrees, with the mast. The Merchant carried $\frac{1}{4}$ oz. suspended in the same manner, making an angle of 30 degrees.

Each loaded with 3 lb. 7 oz. and both having an equal weight suspended (2 oz.), Sharp made an angle of $57\frac{1}{2}$, and Merchant one of 22 degrees. The weights in both cases were removed to the opposite yard-arm to correct any inclination in the mast or dip of the yard, and the medium of the angles is given.

H

EXPERIMENT V.

Was expressly made to prove the advantage of having upright deadwood fore-and-aft. Two models were formed, of the same proportions as the vessel built at Nine Elms (Vauxhall), and every part alike excepting the deadwood being formed in the one in the usual manner, as fig. 2, Plate VII. the other, fig. 3, with upright deadwood. These two models were drawn through 14 feet water, with equal weight. On an average of six trials, without any ballast, No. 3 gained $\frac{1}{2}$ an inch upon No. 2, but when loaded with 18 oz. their speed was equal.

When drawn broadsides, with $\frac{1}{2}$ oz. weight, No. 2 passed through 14 feet, whilst No. 3 moved through only 13 feet, by repeated trials, shewing the injury done by filling up instead of leaving the deadwood perpendicular, for greater opposition to leeward.

EXPERIMENT VI.

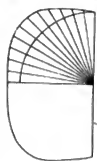
A model of a London wherry, 20 inches long, 4 wide, and $1\frac{1}{2}$ deep, and a model of a wherry on the new system, of the same dimensions, were drawn through 14 feet of water, with equal weights. The wherry gained, on an average of 12 trials, one inch ahead of the London wherry, or $\frac{1}{16}$ part of the whole distance.

PLATE I.

Sectional Model .32 Cal. an Inch.



Center Section of Model
FIG. 2.



Center Model
FIG. 3.



Iron Clamp
FIG. 5.



Fig. 6. An Inch.



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REFERENCES.

PLATE I.

- Fig. 1. A jointed model of the barque Annesley, which was formed upon a scale of $\frac{1}{2}$ an inch to a foot. A. Points of angular sections.
- Fig. 2. Centre section. See also Plate II. fig. 1 and 2.
- Fig. 3. Centre mould, formed in two courses, from the lines of fig. 2.
- Fig. 4. Moulds set up. A. A. The fore-and-aft mould, with the centre plank laid on. B. B. B. the vertical moulds. C. C. The bow and stern trimmers, to receive the ends of the fore-and-aft planking. D. D. Sheer mould, at first connected with the trimmers, but afterwards removed.
- Fig. 5. Iron clamps. A. The point driven into the mould. B. The bend which touches the plank when home to the mould, and receives an inch wood screw, by which the plank is fixed in its position.
- Fig. 6. A. The longitudinal, B. The transverse, course of planking.
- Fig. 7. Profile of the vessel finished. A. A. Upright deadwood. B. B. Fore-and-aft planking to dead wood. C. Bilge, or side keels.

PLATE II.

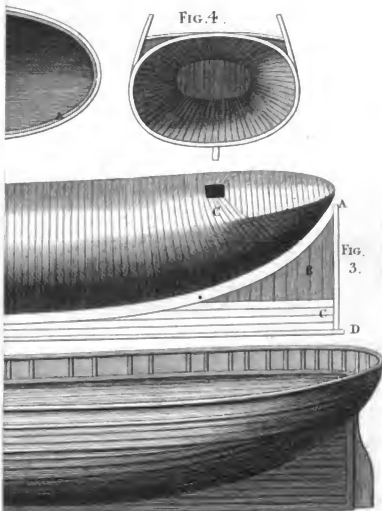
- Fig. 1. A. A. A. Semi-centre section of the model made for the Nine Elms vessel. B. B. B. A semicircle described from the centre C. and divided into parts, through which are drawn the lines D. D. D. &c. to the boundary A. A. A. Apply each to the scale of $\frac{1}{4}$ inch to the foot for the length; thus the line E = 5 feet 4 inches. F. F. Perpendicular lines,

drawn from the points O. O. to the base H. to correct any error in the figures.

Fig. 2. A semi-centre mould made from the lines of fig. 1, in two courses; A. A. The first. B. B. The second course. C. The brace.

Fig. 1. I. I. Shew five courses of planking, three longitudinal, and two athwart. K. K. Two additional courses up to the brackets in dotted lines. L. The brackets whereon to lay the platform. M. The staunchions let into the brackets. N. The rail. O. The bulwarks, in two courses. P. The belt, and line from the mast head, to shew that the channels do not require to project. R. Upright deadwood let into the two centre extra thick planks of the outer course. S. Fillet to keep the deadwood firm. T. The Platform, reducing the elliptic curve to a flatter surface.

Fig. 3. Section of the same vessel, 10 feet from her stern-post, where the curve of her sides and deck becoming too acute for bending the transverse planking round it advantageously, its direction tends towards the centre, as shewn at C. Plate III. Fig. 2. A. A. The deck. B. B. B. The sides and bottom. C. C. The shelf-pieces let into the moulds and scarphed to the trimmers. D. D. The two last courses allowed to rise above the gunwale for support of staunchions, &c. E. Shews half the upright deadwood. F. The ends of the longitudinal deadwood planking. G. The Fillets to support the deadwood. H. H. H. Lines shewing some of the present modes of filling up, for what is termed a fine bottom or run. I. Plank to cover the ends of the upright deadwood. K. K. Two pieces of timber copper bolted together. L. Upright pieces set upon them. M. Pieces of solid timber filled in to give the appearance of a fine sailing vessel. N. The last course, continued down to the pieces of the keel timber at K.



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Note. All this filling-up is quite inconsistent with the system, and contrary to scientific principles.

- Fig. 4. Fore part of a vessel, shewing the knee of the head, cutwater, &c. A. A. The cutwater. B. The perpendicular, and C. The longitudinal planking. D. A thin elm plank bent round from the scroll of the head and inserted in the cutwater.
- Fig. 5. A. The under view of a breast trimmer. B. The groove cut in it to receive the ends of the first course of planking. C. C. Ends of the shelf pieces scarphed to the trimmer at D. D.
- Fig. 6. Model, called Sharp. A. Mast. B. Yard. C. End of the yard. D. Weight. E. Dotted line intersecting the mast, and forming an angle of $51\frac{1}{2}$ degrees.
- Fig. 7. Model, called Merchant. F. Weight. G. Dotted line intersecting the mast at H. forming an angle of 30 degrees.

PLATE III.

- Fig 1. Deck view of the same vessel, as at fig. 6 and 7, Plate I. A. A. A. Deck clamps, carried round the ellipsis. B. B. B. Double cross planking at the openings, sprung to the curve of the deck mould. C. The first course of longitudinal deck planking. D. The middle course, athwart.
- Fig. 2. View of the Nine Elms vessel. A. Longitudinal, B. Transverse course of planking.

Note. The shelf-pieces scarphed to the trimmers, extend to C. C. about 18 inches beyond that point at which the transverse planking can no longer be bent advantageously, owing to the sudden curve of the sides and deck ; therefore, its direction tends from fore-and-aft to the centre.

- Fig. 3. A. The stern-post rabbeted to the thickness of the upright deadwood. B. The upright deadwood. C. The

longitudinal deadwood planking, making both sides flush.
D. The shoe covering the ends of the perpendicular deadwood.

Fig. 4. An inside forward section of the same vessel.

Fig. 5. The vessel finished except part of two strakes left out, to shew the ends of the brackets.

PLATE IV. A.

Fig. 1. The moulds, fore-and-aft trimmers, curved timbers for wheel course and water delivery, set up on the ledgers, having the first fore-and-aft bottom strakes laid on with the upright wedges, braces, and ground plank

A. A. Fore-and-aft trimmers.

B. B. Fore-and-aft moulds in the centre of channel to which the first fore-and-aft planks are fixed.

C. C. Vertical moulds.

D. D. Angular moulds, fore-and aft.

E. E. Curved timbers, for wheel course and water delivery.

F. F. The first bottom planks, fore-and-aft, carried up and inserted in the trimmers.

G. The first forward centre channel plank from the wheel course carried up and inserted in the trimmer.

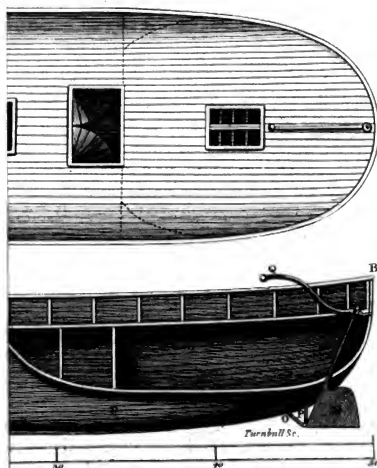
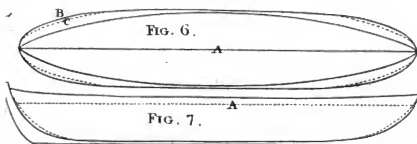
H. The first centre channel plank carried aft to the trimmer, and forward to a rabbet in the after part of the wheel comeings.

I. I. The centre deck plank laid on fore-and-aft the wheel comeings.

K. Wheel comeings framed below, raised, and let down into notches left in the centre moulds to receive it.

L. L. Ledgers in centre of channel course, let into the uprights on which the first plank attached to the fore-and-aft moulds rest.

M. One of the side ledgers placed in the centre, between the channel and bilge.





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N. Uprights for centre ledger.

O. O. Wedges to ditto.

P. P. Fore-and-aft braces to ditto.

Q. Q. Uprights to side ledgers.

R. R. Braces to ditto, fore-and-aft.

S. S. Wedges to ditto.

T. Ground planks laid fore-and-aft, level, or on an inclined plane for launching, to render all firmly uniform.

Fig. 2. Shews a mould immediately forward of the wheel come-ings athwart, and end view of the three ranges of stilts, and side braces with the notches cut into the upright moulds to receive the fore-and-aft moulds; with the ends of the ledgers and wedges, and three first strakes of the fore-and-aft planking laid on.

Fig. 3. Displays the manner she is rigged for a river and ocean steam boat, with masts to strike. The line below the bottom is designed to shew the saving plank of $1\frac{1}{2}$ inch thick.

REFERENCE TO OCEAN STEAM PACKET.

PLATE IV. B.

Fig. 1. Displays a vertical longitudinal section, shewing the mid-channel, and what appears inside above the trunk.

A. Night head, B. Taffrail; distance between 56 feet 4 inches.

C. Centre of the wheel 10 feet diameter, and centre of the vessel.

D. D. The iron paddles, 10 inches deep, revolving within fourteen inches of her draft of water, and 2 feet 9 inches wide.

E. Upright trunk where the wheel plays.

F. F. The outside of the water course, or mid-channel.

G. The fore-castle. H. The fore-cabin. I. The engine room.

K. Ladies cabin. L. After cabin. M. Cast iron rudder case.

N. Iron rudder. O. Fore-and-aft brace. P. Side brace. Q. Iron tiller.

R. Knee of the head.

PLATE IV. B.

Fig. 2. Shews a deck view.

Fig. 3. Middle section athwart looking forward, with wheel hung.

A. The wheel. B. B. The paddles. C. Bulk head.

D. D. The staunchions let into the brackets and fitted to the sides thrown outwards to cast off the spray.

E. The deck. The brackets are shewn by the space formed between the curve of the deck and body of the vessel.

Fig. 4. Stern view.

A. A. Bottom saving planks.

B. Iron rudder and side braces.

C. The belt passing entirely round.

D. Moulding.

E. Plank-share.

F. Bulwarks, between which and the rail are belaying timbers.

G. The rail.

Fig. 5. A. Rudder case, a cast iron pipe of $2\frac{1}{4}$ inches bore, $3\frac{1}{2}$ inches outside diameter; the lower part cut to the rake of the channel bottom; the upper has a flaunch, with screw holes to secure a jointed collar in which the turned part of the rudder-stock plays.

B. Blade of the rudder, consisting of two sheets of iron rivetted through the rudder-stock, which above the blade is round iron of two inches diameter, but flattened, tapering to one inch, where it is rivetted; the two sheets rivetted together form the after part. The acute angle formed by the thickness of the flattened stock diminishing to a point to be filled up with soft wood, rendering it stiff at a trifling expense of weight.

C. A socket of two inches deep, with a cup bottom to receive a round pivot formed on the end of the rudder-stock, into which the fore-and-aft and side braces are welded.

D. Fore-and-aft brace to prevent ropes, &c. from getting foul of the rudder.

E. Side braces. All these braces are of inch round iron.

F. Tiller. The after part is made to fit a square on the rudder stock above the jointed collar, on the end of which is a screw and nut.

G. Lower jointed collar: two plates formed to fit the bottom and filed to the rake of the rudder stock, and well fitted to secure the rudder from vibrating by having too long a bearing. This collar is let in and fastened to the bottom by wood screws that can be readily turned out (having no strain) should it be necessary to unship the rudder; when this, and the upper collar is removed, the rudder will rise out of the socket, and can then be lowered down through the rudder case.

Fig. 6. A. The inscribed figure, consisting of two equal segments of a circle, is given by scientific men as the best form for passing quickest through the water, but in itself unsuitable for sailing or burthen.

B. The circumscribing line is a modification of the figure, the principle only being retained, by means of which bearings are acquired, enabling the vessel to carry sail and burthen admirably.

C. The dotted line shews a nearer approach to the inscribed figure, and probably a shape more adapted for velocity in smooth water; but it is doubtful which would make the quickest passage across the Atlantic, especially when giving to the full built vessel the advantage of side keels, equal to her inferiority in gripe and deadwood, gained by the other.

Fig. 7. A vertical fore-and-aft section of B; the inclined entrance and delivery are the same curve as half of the horizontal circumscribing figure B. as shewn by the depth of dotted line A.

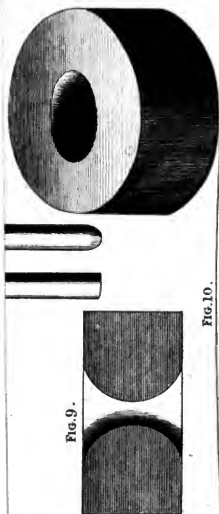
PLATE V.

- Fig. 1. Perspective section of a vessel with two inner decks.
 A. A. Decks, each of three courses, all running athwart, and breaking joints. C. C. Brackets for the platform. D. D. Upper deck. E. E. Staunchions and bulwarks. F. F. Deck clamps, upper and lower. G. G. Bilge-keels. H. Bulk head.
- Fig. 4. Trenails from the splitting gauge tool.
- Fig. 5. Ditto chamfered.
- Fig. 6. Ditto compressed.
- Fig. 7. Ditto pointed.
- Fig. 8. Compressing tool of steel.
- Fig. 9. Section of ditto.
- Fig. 10. Part of the body of a vessel consisting of five courses, with the manner of repair. A. A. Extent of injury supposed, and made applicable to an external or internal repair, or to both. B. B. Outside course ripped off for the shift, and filled up afterwards. C. C. Inside course ripped off and repaired. D. D. Graving pieces bevelled, meeting at the centre A.
- Fig. 11. A gimblet bit.
- Fig. 12. The American double-cutting twisted centre bit.

PLATE VI.

- Fig. 1. Splitting gauge tool. A. Marker. B. Gauge. C. Splitter. D. D. Nuts and screws keeping the marker and splitter firm to the gauge.
- Fig. 2. A part of the head of a lathe. B. Mandril. C. Oil hole pin.
- Fig. 3. Pointing tool. A. Has a female screw for the mandril of B. fig. 2. B. Gauge cutter. C. C. Slits and screws to alter the cutter. D. A wood stop, to prevent the pin from entering too far. E.* A hole tapering to the size of the pin

* This letter of reference is omitted in the Plate.



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where it enters to the cutter. F. Joint unscrewing at this part, when pins of a different size are required.

Fig. 4. Shews the part unscrewed.

Fig. 5. London Wherry.

PLATE VII.

Fig. 1. A. Flat cistern, 16 feet long, 5 feet 6 inches wide, and 10 inches deep. B. The water. C. C. C. Models. D. D. A plank fixed to a wall, into which three brass pullies were screwed. E. E. E. Three pullies in the plank ranging with three on the cistern. F. F. F. Silk cords passing the pullies, and attached to the models in the cistern. G. G. G. Equal weights at the other ends of the cords.

Fig. 2. Vessel built at Nine Elms as she was filled up. See Plate II.

Fig. 3. The same with her deadwood upright.

Fig. 4 and 5. Two Experimental Figures.

Fig. 6. Part of a ship's side with three tier of open ports, square and circular.

Fig. 7. Profile of a circular port in two parts.

Fig. 8. Perspective view of the inner and outer port.

PLATE VIII.

Shews the waist and form of the planks when spiled, for longitudinal planking, on a scale of half an inch to a foot.

Fig. 1. A. 12-inch board 19 feet long. A. A. Two planks spiled out of it, $7\frac{1}{2}$ inches wide at one end, and 2 inches wide where they enter the trimmers, shewing 15 inches of the body of the vessel covered out of a 12 inch plank,

Fig. 2. A. A. The two planks next the centre, leaving a straight edge outside, as usual. B. B. &c. Planks spiled for each side. C. C. C. Lines shewing the progressive gain of the planks as they advance round the trimmers and cover the body.

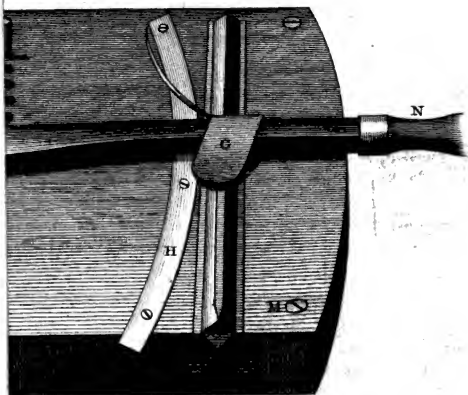
ANNESLEY'S METAL SPILING LATH.

- A. A. A. The outside plates. B. B. B. Inside plates. C. C. C. Fixed pivots on which the plates turn. D. D. D. Circular slits allowing a screw pin fixed in the inside plates, to travel as the joints are bent; the whole is kept firm by thumb screws. The dots in the inside plates represent holes made for tacks to keep the lath in its place, until fixed by the nuts to bear removal. The tacks may be made with a square head to be readily drawn.

CHAMFERING TOOL.**PLATE IX.**

- The chamfering of the pins has hitherto been performed by boys with a chisel, and liable to an uncertainty in the space for the head, and the angle took off.
- The tool here presented, leaves the heads all equal for the same sized pin, and takes off the angle on both sides the same, leaving the part to be compressed a regular octagon, and evidently with much greater dispatch; and so simple is the whole process of forming trenails, it might be performed at an asylum for the blind.
- A. A piece of plank 14 inches long, $8\frac{1}{2}$ inches wide, $1\frac{1}{4}$ inch thick.
- B. A dovetail cut in the plank, into which are fitted different pieces, with a right angle sunk in them according to the size of the trenail required to be chamfered. C. A trenail placed, the end projecting a little beyond the dovetail, to allow turning readily. A ring is shewn in the dovetailed saddle to draw it out by, when required to change the size.

IX.



From the Engraving

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- D. A plate of iron 14 inches long to the handle, 1 inch wide, and $\frac{3}{8}$ inch thick, jointed at E. being twisted to an angle of 40 degrees, where the cutter is inserted.
- F. The turning pivot. G. The cutter, a piece of tempered steel $3\frac{1}{2}$ inches long, 2 inches wide, and $\frac{1}{8}$ inch thick, dovetailed at right angles into the stock or plate, and kept in its place by a screw in the under part of the stock, pressing it to the sides of the dovetail.
- H. A circular iron plate $\frac{1}{2}$ inch wide, and $\frac{1}{4}$ inch thick, screwed to the plank A. on which the plate D bears, that forms a gauge to the depth of the cut required.
- I. Pins to limit the play of the tool, to the various lengths of the trenails.
- K. Holes in the plank, to receive the after pin as the trenails vary in length.
- L. A brass washer for the pivot to play in.
- M. Wood screws to fasten the tool to the bench.
- N. The handle

This tool is only calculated in extent for trenails of 8 inches in length and $\frac{1}{4}$ inch square, each angle of which a lad of 14 years of age may with ease chamfer at a single stroke; for larger, the tool must be increased in dimensions.

PLATE X.

Fig. 1. Shews the profile of a ship whose greatest breadth is in the centre, and whose fore-and-aft divisions are perfectly equal. In the middle is placed her main mast, and at equal distances from bow and stern her fore-and-mizen mast.

A. B. C. An isosceles triangle. D. The centre of the main mast, cutting it into two equal right angled triangles. The fore-and-mizen masts shew sails, without regard to particular proportions, merely to explain the principle.

This vessel being a perfectly regular figure, and having an equal press of canvass fore-and-aft, her centre must be the centre of motion when the helm is amidships. The line A. B. cuts off as much of the forward sails as B. C. of the after ; allowing them to be placed equally. By this disposition, one part counterbalancing the other, it seems evident that the sails of regular figures may be so judiciously placed, that the vessel when sailing on a wind, or free, will always continue to take her helm right fore and aft.

E. The gripe forward, which is much lessened, and any counteraction of which is left to the judicious consideration of the builder.

It appears that on this principle, the vessel sailing upon an even keel, and having her water line always equal fore-and-aft, will not alter her course by careening when it blows fresh. But much must, after all, be confided to the good sense, science, and attentive observation of the captain of every vessel.

Fig. 4. A. A. Annesley's direct and uniform boring machine for two men. B. B. Flaunches to extend a foot or more, to keep the machine steady. C. C. Holes to receive a taper wood screw to fasten the flaunches to the side, deck, or bottom of the vessel for boring. D. Upright bar 7 feet high, 4 inches wide, and $\frac{5}{8}$ thick. E. Moveable cross bar $3\frac{1}{2}$ feet long, 3 inches wide, and $\frac{1}{2}$ an inch thick. F. Clamp that receives and carries the cross bar. G. A screw to press the upright against the cross bar, to prevent its sliding when boring. H. H. Leading screws passing through the end of the cross bar into the smooth collar, with points entering the progressive screw. H. The progressing screws, cut close or open, according to the size of the boring bit, and quality of the wood ; but all made to fit the same collar and pod in

the stock ; the outside of the thread square, to move easily and steadily in the smooth collar K. K. Stocks. L. L. Boring bits of all sizes made to fit the same stocks. M. M. The arms rounded, allowing the hand on the stock to work as near as possible without injury. If the stock occupy 12 inches, the length of the arms must be 20 inches, for boring 8 inches. For deeper boring the machine must be proportioned.

Fig. 5. A single hand boring machine for moving along the stage, that may be used in the inner courses of large vessels.

A. The upright may be of wood formed in two pieces, having a groove lined with sheet iron to move in, with side springs to sustain its weight when shifted. B. The sill, into which the upright is framed. C. A brace. D. D. Feet on which the workmen stand, whose weight steadies the machine.

Note. The collar and the leading and progressing screws are the same as in fig. 4.

Fig. 6. An open slide bar, which the Inventor had made after fig. 4 was engraved, to be substituted in the place of the plain bar there described. The open bar is $4\frac{1}{2}$ inches wide, $\frac{1}{2}$ inch thick, and 6 feet long.

- A. A. Spaces of 2 inches square to admit the sliding collars.
- B. The opening, with bevelled edges to retain the collars.
- C. C. The sliding collars, with a sunk bevel to fit the bar.

Advantages of the Boring Machine, for Ship building particularly, and for other purposes generally.

As boring and trenailing constitute a great portion of the labour in the New System, it has long been an important object to lessen needless fatigue without abridging manual labour; to bore the holes more evenly and directly; and to render the inclination of the

trenails more uniform, also save the bits from twisting or breaking, by the irregularity of the workmen, or springing stage, or in meeting with parts in the wood where the augre bites so greedily as to endanger the tool. It is material to observe, that the more perfect the hole the less force is required to drive the same sized trenail, and the cohesion becomes complete and tenacious.

Such a machine the Author has succeeded in inventing, and he offers it for public benefit, as simple in operation, and certain in effect. It will be found most serviceable in his system in the last course, where the holes are most numerous, the trenails largest, and the boring deepest. The planks, especially in the waist and body of the vessel, may be laid on with comparatively few trenails, sufficient to keep them in their places, until there is room for the borers to fix the machine for close trenailing.

Four taper wood screws through the flaunches will enter the wood without boring; nor need they pass through the course to keep them sufficiently firm. A stout machine for boring holes of $1\frac{1}{4}$ inch in diameter will not require to weigh above 90lbs. and may be removed and replaced in three minutes by two people. Allowing the extent of its boring to be six feet each way, horizontal and vertical, it will take in 36 square feet, and supposing six trenails required to the foot, it will bore 216 holes at one station, by only moving the collar in the groove of the sliding bar for each vertical range. As the distances horizontally should be equal, the cross bar may be marked, so that the collars may be moved their regular distances without repeatedly measuring. There being only one motion, and that circular, and the strain at all times equal by means of the progressing screw, the workman may be perfectly steady and expeditious without severe exertion, in all parts of the vessel; but especially in the bottom; in truth, it may be said he will work with ease and comfort compared with the present manner of boring. The bit is instantly relieved

by turning the leading screw out of the cut of the progressing screw and drawing it through the smooth collar, or by reversing the bit. In the use of the common hand stock the Inventor found that a $\frac{1}{8}$ inch gimblet bit, boring $4\frac{1}{2}$ inches through the course of Quebec white oak was as great a strain as the bits would bear, or the strength of the workmen could overcome, and the expense of broken tools, with the consequent loss of time, formed a very considerable charge. He therefore advises the use of the single hand wood machine, that moves along the stage, for bits of this or larger size.

Note. It may be serviceable to those interested in this system of ship building, and it is due to an ingenious mechanic, to mention, that all the tools described in this work, as well as working models of the double boring machine, and of the rudders, were made by Mr. Stone, of Warwick Street, Golden Square, who readily conceived the designs, and executed them justly, at a very moderate charge.

NATIONAL SAVING.

<i>Lloyd's Register of sea vessels</i> gives, for tonnage, about	2,650,000
Coasters, not there included, lighters, canal barges, &c. employed in <i>internal navigation</i> , are considered to make an addition of at least - - - -	1,500,000
<i>The Royal Navy tonnage</i> is estimated at about - -	850,000
Total tonnage,	<u>5,000,000</u>

From decay, foundering, and wrecks, an average of ten years may be taken as a *long life for vessels on the present construction*.

An annual building of 500,000 tons, may, therefore, be stated, as requisite to keep up the stock. If that quantity be built on an average at £12. per ton on the old plan, then the cost of the present *annual* supply is about - - - - 6,000,000

After making *liberal* allowance to the builder, the estimates on this system will not exceed two-thirds of this amount, making - - - - 4,000,000

Thus there will be a national annual saving of £2,000,000. as a simple *first* saving, exclusive of the economy which may take place in every department from the adoption of this System of Naval Architecture, and without calculating upon its other specified advantages.

FINAL REMARKS.

THE Author considers it important to remind the Builder, that in the last vessel he built the (Hope ocean steam boat) the method adopted there in forming the fore-and-aft mould for the inside instead of outside (as in the former vessels), and in the manner described of setting up, he found great advantages in *facility* and *convenience*; and particularly in placing the fore-and-aft trimmers above the deck, which affords the utmost security to hause pieces, night and cat-heads, belaying timbers, &c. and precludes the necessity of shelf-pieces, as used in the Nine Elms vessel.

The fundamental principle of building with longitudinal and athwart courses is extended to wherever it is practicable; from the scroll of the head to the rudder-stock, all is bound together in the firmest manner in which wood and wood can be united.

The staunchions and brackets for vessels of war can be most firmly secured together, and the bulwarks and rail carried all round in repeated courses; thus rendering the upper works a complete whole, and yet independent of the body (or barrel) of the vessel.

From what has been proved respecting strength, it may be readily admitted, that vessels of the greatest present tonnage may (by being built long and low), carry their full complement of guns and weight of metal on two decks; the advantages of which, in lessening the expense, giving additional security in spars and rigging, producing stability in working and sailing the ship, can be justly esteemed by the Gentlemen of the Navy.

The technical terms necessary to be studied in order to understand such a complicated structure as the hull of a vessel of war (built on the old method), debars many from the pursuit of the science of Naval Architecture, and is probably the reason that its principles have not been more generally investigated by men of general science.

From the simplicity of construction and uniformity of figure displayed in the New System, but few terms are required, and most of them of general import, consequently its merits or defects are obvious to the public judgment.

In reviewing these few pages, the Author found he had assumed for his system every property desirable in a vessel which, to a casual observer, looks suspicious, as there are few important discoveries but are attended with minor sacrifices. Yet is he so far from retracting, that he feels convinced that a short period of practice will afford proofs that in every particular, the advantages of the New System are here under-rated.

PREMIUMS FOR THE USE OF THE PATENT.

To those disposed to build, five shillings per ton, as registered. This sum is only two per cent. on vessels built at £10. per ton, which is the lowest price of ordinary sized merchant vessels built with detached timbers; but considering the actual tonnage of vessels built on the New System, this premium will not amount to $1\frac{1}{2}$ per cent.

To the Public the Author gives the result of many years study, experiments, and practice, the description of his method, and free use of the tools and instruments invented by him.

Applications to the Author will be received by Leonard Cox, Esq. 22, St. Dunstan's Hill, Tower Street, London; and by Lawson Annesley, Esq. Belfast, Ireland.